BICYCLE FACILITY SELECTION
A COMPARISON OF APPROACHES

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All images by author, except as noted.

Introduction

Technical information on the design of different bicycle facilities has dramatically improved in recent years. The fourth edition of the AASHTO Guide for the Development of Bicycle Facilities, published in 1999, is more than twice the size of its predecessors and is based on considerably more research and practice than earlier versions. Many state and local agencies have adopted their own design practices that exceed recommendations in the AASHTO guide for such things as bike lane width, trail width, and intersection treatments.

However, there is still considerable debate over the appropriate choice of bicycle facility type in any given set of circumstances. When is a striped bike lane the appropriate design solution rather than a simple shared lane or a multi-use path? At what traffic speed or volume does a shared lane cease to provide the level of comfort sought by most bicyclists?

As this report shows, there are no hard and fast rules or warrants that apply across the board. Engineering judgment and planning skills will always remain critical elements of this kind of decision. And yet this report, which analyses more than 20 national, state, and local manuals that have been developed to provide guidance as to when one type of facility is recommended over another, clearly shows that there are some general ranges within which this type of decision can be made.

As author Michael King notes, there are also critical differences between North America and the rest of world that will influence the choice of facility in a given corridor. Because US crash statistics are dominated by fatalities and injuries to bicyclists riding on the sidewalk and/or against traffic, separated facilities are generally reserved for situations where there are few or no traffic movements across the path or they are in their own right of way. No North American city grants cyclists the general right to ride in both directions on one-way downtown streets as they do in many Swiss and German cities.

Finally, the guide outlines an important and frequently ignored approach to bicycle planning and facility design: reducing vehicle speeds and or traffic volumes to accommodate bicycles on streets that may not be wide enough for a striped bike lane or other potential treatment.

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Background

The genesis of this project came in a context-sensitive design training session for New Jersey DOT. In a discussion on accommodating pedestrians and cyclists on urban streets, the question was asked "how narrow is too narrow?". The query came from a roadway designer who had been receiving conflicting information from the walking and cycling communities. The pedestrians wanted narrow, slow streets that were easy to cross. The cyclists wanted good cycling infrastructure, which often meant increased width. So where could one find the answer?

Direction in the 1996 New Jersey DOT bicycle facilities design guide can be summarized as follows:

For speeds of 35 mph and under and:
- volumes of 1200 and less - no bike-specific facilities, drivers and cyclists can comfortably share the roadway;
- volumes between 1200 and 10,000 - a wide curb lane;
- volumes of 10,000 and over - a bike lane.

For speeds of 40 mph and over and:
- volumes of 1200 and less - a wide curb lane;
- volumes of 1200 and over - a bike lane.

Yet empirically we know that riding alongside cars traveling at 35 mph is much different than 20 mph. For example Australian guidelines say that no bike-specific facilities are necessary when the speed differential between cyclists and vehicles is 12 mph or less. If the 85th percentile bike speed is 12 mph, then one may mix traffic up to 24 mph. Similarly the Australians provide separate facilities when the speed differential is 25 mph and over, or where traffic travels at 37 mph and above.

This brings up the second half of the question: when to separate? At some point the speed/volume characteristics of a roadway are too great for a cyclist to ride comfortably and safely. They need to be separated from the vehicle traffic. This does not necessarily mean a separate off-street shared use path. It may mean a wide bike lane with median-type striping ala New York City. It may mean flexible bollards like those found in Montreal. It may mean a Danish "cycle track" – a bike lane raised half way up the sidewalk curb. It may mean simply an eight-foot wide bike lane, as found in Davis CA.

The double sided question: when to mix and when to separate. One way to answer this is to see what various guidelines had to say.

Guidelines Surveyed

Material from 36 sources was reviewed and 16 relevant guidelines were found, six from overseas and ten from North America. The ten others were not included for they did not specifically discuss bicycle facilities with respect to vehicle speed/volume.

Overseas Guidelines

- Australia (AU)
- Denmark (DK)
- Germany (DE)
- Netherlands (NL)
- United Kingdon (UK)
- Western Australia Planning Commission (WAPC)

North American Guidelines

- United States – FHWA (US)
- Minnesota (MN)
- New Jersey (NJ)
- Oregon (OR)
- Wisconsin (WI)
- Cambridge, MA
- Davis, CA
- Hamilton, ON
- Portland, OR
- Center for Livable Communities, CA (CLC)

Guidelines reviewed but not included

- American Association of State Highway and Transportation Officials (AASHTO)
- American Planning Association (APA)
- Florida
- North Carolina
- Broward County, FL
- Chicago, IL
- Madison, WI
- New York City, NY
- Philadelphia, PA
- Tucson, AZ

SOURCE	GUIDELINE	YEAR	URL
Austroads (Australia)	Guide to Traffic Engineering Practice, Part 14 – Bicycles	1999	www.austroads.com.au
Danish Road Directorate	Collection of Cycle Concepts	2000	www.vd.dk
Forschungsgesellschft für Strassen- und Verkehrswesen (FGSV, Germany)	Empfehlungen für Radverkehrsanlagen	1995	www.fgsv-verlag.de
CROW (Netherlands)	Sign Up For The Bike	1993	http://www.crow.nl/english_old/html_e/publ_eng/pube_74.htm
Institution of Highways and Transportation (United Kingdom)	Guidelines for Cycle Audit and Cycle Review	1998	www.iht.org
Western Australian Planning Commission	Liveable Neighbourhoods, Edition 2	2000	www.planning.wa.gov.au.
Federal Highway Administration (USA)	Selecting Roadway Design Treatments to Accommodate Bicycles	1994	www.bikewalk.org/library.htm
Minnesota DOT	Bicycle Transportation Planning and Design Guidelines	1996	www.dot.state.mn.us/sti/biking.html
New Jersey DOT	Roadway Design Manual, Chapter 16 – Bicycle Facilities (draft)	2002	www.state.nj.us/transportation
Oregon DOT	Bicycle and Pedestrian Plan, Section II 1 B: Design Standards		www.odot.state.or.us/techserv/bikewalk/plantext/onrdbkwy.htm
Wisconsin DOT	personal correspondence		
Cambridge MA	personal correspondence		
Davis CA	personal correspondence		
Hamilton ON	Design Guidelines for Bikeways	1999	
Portland OR	Bicycle Master Plan	1996	www.trans.ci.portland.or.us/Plans/BicycleMasterPlan/recomend.htm
Center for Livable Communities (California)	Street Design Guidelines for Healthy Neighborhoods	1999	www.lgc.org/bookstore/land_use/publications/healthystreets.html
University of North Carolina Highway Safety Research Center	Bicycle Compatibility Index	1998	www.hsrc.unc.edu/research/pedbike/bci/

Table 1: Sources

Methodology

The 16 guidelines were distilled into speed-volume matrices for easy comparison. To compensate for the fact that different jurisdictions use various terminology to describe similar bicycle facilities the following terms were used:

N = narrow lane, 9-12 feet wide. For the purposes of this exercise 11 feet. Cyclists would either operate in the margins or take the lane. No special provisions are provided for the cyclist, i.e. mixed traffic or share the road.

W = wide lane, 13-15 feet wide. For the purposes of this exercise 14 feet. Cyclists generally can operate along side vehicles but may take over the lane. Some refer to this as a shared lane or a wide curb lane.

B = bike lane, 4-6 feet wide and striped (marked). For the purposes of this exercise 5 feet adjacent to an 11-foot travel lane. In some locations the bike lane doubles as a narrow shoulder.

S = separated lane. Anything wider than a 6-foot on-street bike lane. This includes 7 and 8-foot wide bike lanes, bike lanes with separation striping or markings, bike lanes separated by bollards or a curb, raised bike lanes (cycle tracks), bike lanes on the sidewalk or completely separated paths (shared use path).

In translating the guidelines certain assumptions had to be made. The following parameters were used to ensure an accurate comparison. If a guideline specified a specific condition (parking, volume per lane, 85^{th} percentile speed) it was accounted for, but mostly assumptions were made.

- two-way street, one lane each direction
- urban sections (curbs and sidewalks)
- speed is 85^{th} percentile or design; if speed limit used, add 10 mph; if average speed used, add 5 mph – this is consistent with the BCI
- volume is average daily traffic, both directions, maximum 12,000; if hourly volumes given, multiply by 10; if no lane number is given assume 2 lanes
- on-street parking
- commercial land use
- non-vehicular (casual, average & child) cyclists
- 10% trucks
- 10% right turns
- 50% parking utilization rate

The Dutch, Danes, British FHWA, Minnesota and New Jersey already had selection charts so the translation was fairly straightforward. Some guidelines were fairly vague so a qualified guess was made. For example “no facilities on local streets, which are posted 25 mph” translated to narrow or wide lanes for 35 mph and below. Others listed maximums for mixed traffic and minimums for bike lanes. It was assumed that in between would be wide lanes.

The 16 matrices are found in Tables 2-17.

Comparisons

After creating the matrices they were compared to each other. They break down into two distinct categories: North American and overseas. Guidelines from the US and Canada are more planning oriented – about how to increase cycling and provide more bike-specific facilities. Overseas guidelines are much more inclusive in terms of seeing the bicycle as an integral part of the transportation system – making each street safe for cyclists.

North Americans rely much more on wide lanes for bicycle accommodation than their counterparts overseas. North Americans generally do not include separated facilities in their guidelines except “where appropriate”, “to connect specific location”, and “if space permits.” Elsewhere vehicle-bicycle separation is more common and encouraged.

<u>Level of Service</u>
The matrices were compare to the baseline levels of service in the Bicycle Compatibility Index (BCI). The BCI is typically used to model the LOS of an existing facility. In this case the spreadsheet was used backwards to create a series of speed-volume matrices. One matrix was created for each LOS A through F, see Tables 18-23.

[Note: the BCI applies to suburban and urban locations, applies to experienced and casual cyclists, and the limits of the regression model are 25-55 mph and 1800-18000 ADT.]

The 16 matrices were broken into two groups, North American and overseas, and plotted by facility type (narrow, wide, bike lane/shoulder and separated lane/path). The levels of service for cyclists were then overlaid to show which each facility provided, see Figures 1-4. From this we see that North Americans generally provide LOS D while the Europeans and Australians provide LOS C. Regardless of location, narrow and wide lanes generally provide LOS D, bike lanes LOS C and separated lanes LOS B.

<u>Aggregate</u>
The last step was to see if there was a “golden” matrix – one that independently reappears everywhere. There is none. Even within Europe the guidelines vary even though it is hypothesized that some of the guidelines begat others. Overall there are simply too many differences to meld together. That said, it is interesting to take an aggregate of all the matrices, as in Figures 5-7. Figure 5 would be the North American chart (notice the lack of separated lanes), Figure 6 would be the overseas chart (notice the lack of wide lanes), and Figure 7 would be the universal chart. While not normalized (witness the extra large wide lane at 30 mph in Figure 7) this approaches the possibility of a common design tool or standard.

Discussion

Ultimately a goal of this exercise is to produce a design tool that may be used by the bicycle and pedestrian design community to obtain higher quality walking *and* cycling facilities - **minimum standards**. These could be used to understand the range of possibilities, and then design accordingly. They could also be used by planners and advocates to lobby for better facilities.

For example if a street has 4000 ADT and 25 mph speeds, under the Danish guidelines this street would receive a bike lane. Let's say there was not sufficient width to stripe a bike lane, there are essentially three options:

- Widen the street, narrow the vehicle lanes or remove a vehicle or parking lane to provide space for a bike lane.
- Reduce the vehicle volume to 3000 to put it under the threshold for mixed traffic, whereas no bike lane would be necessary.
- Reduce the vehicle speed via traffic calming to 20 mph which would put the volume under the threshold for mixed traffic, then no bike lane would be necessary.

Just as other professions have minimum standards, why should not the pedestrian/bicycle community not produce minimum standards for their facilities?

Another point of discussion is the use of **separated lanes**. In this comparison the term separated lane refers to anything wider than a 6-foot on-street bike lane (as defined above). They are not necessarily off-street bikeways, rail-trail or other facility divorced from the regular street network.

Figures 8-29 visually demonstrate the ranges of separation. The images are arranged from least separation (mixed traffic) to most separation (grade-separated bikeway). The idea is to show that even within the broad planning categories there are multitudes of design possibilities. Figures 8-13 show narrow lanes. Figures 14-19 show wide lanes, bike lanes and shoulders. Figures 20-29 show various separation techniques, many of which already exist in North America. For more images click on www.pedbikeimages.org.

Be aware though that regional differences exist. For example Davis CA routinely uses 8-foot wide bike lanes while Cambridge MA forbids bike lanes wider than 6 feet. They tend to be used as vehicle lanes.

Finally there is the debate between **planning and design constructs** in terms of facility selection. These speed/volume matrices should not detract from identifying bicycle routes and clearly marking them. Streets on designated bicycle routes should always receive some type of on-road markings regardless of vehicle speed or volume. This is a planning construct which serves a different purpose than the design of specific facilities.

That said, cycling network plans vary widely and could maybe benefit from this design approach. Tucson AZ has bike lanes on 40-foot wide residential streets with volumes around 200 ADT. 40-foot wide streets in Chicago have four lanes and carry up to 40000 ADT, yet have the same size bike lanes.

Overseas Speed-Volume Matrices

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	all	all	all	<3000	<3000	--
W	**Wide** lane	--	--	--	>3000	--	--
B	**Bike lane** or shoulder	--	--	--	--	>3000	--
S	**Separated** lane or path	--	--	--	--	--	all

Table 2: Australia Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<3500	<5000	<3500	<2000	<500	--
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane** or shoulder	--	5000-10000	3500-8500	2000-7000	500-5500	<4000
S	**Separated** lane or path	--	>10000	>8500	>7000	>5500	>4000

Table 3: Denmark Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	all	all	<15000	<10000	<5000	--
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane**	--	--	>15000	--	--	--
S	**Separated** track or path	--	--	--	>10000	>5000	all

Table 4: Germany Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<8000	--	--	--	--	--
W	**Wide** lane	--	<9000	<6000	<4000	<2000	--
B	**Bike lane** or shoulder	--	9000-10000	6000-9000	4000-6500	2000-2500	--
S	**Separated** lane or path	--	>10000	>9000	>6500	>2500	all

Table 5: Netherlands Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<3500	<3200	<3000	<2500	<1700	--
W	**Wide** lane	3500-6200	3200-6200	--	--	--	--
B	**Bike lane** or shoulder	6200-10000	6200-10000	3000-8500	2500-5200	1700-11500	<8000
S	**Separated** lane or path	10000-15000	10000-15000	8500-15000	5200-15000	11500-15000	8000-15000

Table 6: United Kingdom Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	<1000	<3000	--	--
W	**Wide** lane	--	--	--	--	<3000	--
B	**Bike lane** or shoulder	--	--	--	--	3000-20000	15000-35000
S	**Separated** lane or path	--	--	--	--	--	--

Table 7: Western Australia Planning Commission Matrix

NORTH AMERICAN Speed-Volume Matrices

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	--	--	--	--
W	**Wide** lane	<10000	<10000	--	--	--	--
B	**Bike lane** or shoulder	>10000	>10000	all	all	all	all
S	**Separated** lane or path	--	--	--	--	--	--

Table 8: United States (FHWA) Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<10000	<10000	<500	<500	<500	--
W	**Wide** lane	--	--	500-5000	500-5000	<5000	<500
B	**Bike lane** or shoulder	--	--	>5000	>5000	>5000	>500
S	**Separated** lane or path	--	--	--	--	--	--

Table 9: Minnesota Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<1200	<1200	<1200	<1200	<1200	--
W	**Wide** lane	1200-10000	1200-10000	1200-10000	1200-10000	1200-10000	<1200
B	**Bike lane** or shoulder	>10000	>10000	>10000	>10000	>10000	>1200
S	**Separated** lane or path	--	--	--	--	--	--

Table 10: New Jersey Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	all	all	all	<3000	<3000	<3000
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane** or shoulder	--	--	--	>3000	>3000	>3000
S	**Separated** lane or path	--	--	--	--	--	--

Table 11: Oregon Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	<2000	<2000	<2000	<1000
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane** or shoulder	--	--	>2000	>2000	>2000	>1000
S	**Separated** lane or path	--	--	--	--	--	--

Table 12: Wisconsin Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<3000	<3000	<3000	--	--	--
W	**Wide** lane	>3000	>3000	--	--	--	--
B	**Bike lane** or shoulder	--	--	>3000	all	all	all
S	**Separated** lane or path	--	--	--	--	--	--

Table 13: Cambridge, MA Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	all	all	all	--	--	--
W	**Wide** lane	--	--	--	all	all	--
B	**Bike lane** or shoulder	--	--	--	--	--	all
S	**Separated** lane or path	--	--	--	possible	possible	possible

Table 14: Davis, CA Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<6000	<6000	--	--	--	--
W	**Wide** lane	6000-10000	6000-10000	<6000	<6000	<6000	--
B	**Bike lane** or shoulder	--	--	>6000	>6000	>6000	all
S	**Separated** lane or path	--	--	--	--	--	--

Table 15: Hamilton, ON Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	<3000	<3000	<3000	<3000	<3000	--
W	**Wide** lane	--	--	--	--	--	<3000
B	**Bike lane** or shoulder	>3000	>3000	>3000	>3000	>3000	>10000
S	**Separated** lane or path	--	--	--	--	--	>20000

Table 16: Portland, OR Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	all	<200	--	--	--	--
W	**Wide** lane	--	200-600	--	--	--	--
B	**Bike lane** or shoulder	--	3000-10000	3000-20000	3000-40000	20000-40000	20000-40000
S	**Separated** lane or path	--	--	--	--	--	--

Table 17: Center for Livable Communities Matrix

LEVEL OF SERVICE Speed-Volume Matrices

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	--	--	--	--
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane** or shoulder	--	--	--	--	--	--
S	**Separated** lane or path	--	--	1800-3250	1800-2000	--	--

Table 18: Bicycle Compatibility Index - LOS A Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	--	--	--	--
W	**Wide** lane	--	--	--	--	--	--
B	**Bike lane** or shoulder	--	--	1800-3250	1800-2000	--	--
S	**Separated** lane or path	--	--	3250-18000	2000-18000	1800-18000	1800-18000

Table 19: Bicycle Compatibility Index - LOS B Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	--	--	--	--
W	**Wide** lane	--	--	1800-3000	--	--	--
B	**Bike lane** or shoulder	--	--	3000-11000	1800-10000	1800-8500	1800-7000
S	**Separated** lane or path	--	--	11000-18000	10000-18000	8500-18000	7000-18000

Table 20: Bicycle Compatibility Index - LOS C Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	1800-6500	1800-5250	1800-4250	1800-3250
W	**Wide** lane	--	--	6500-10500	5250-9000	4250-7500	3250-6000
B	**Bike lane** or shoulder	--	--	10500-18000	9000-18000	7500-17000	6000-15250
S	**Separated** lane or path	--	--	--	--	17000-18000	15250-18000

Table 21: Bicycle Compatibility Index - LOS D Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	1800-13750	1800-12250	1800-10500	1800-10000
W	**Wide** lane	--	--	13750-18000	12250-16250	10500-14750	10000-13250
B	**Bike lane** or shoulder	--	--	--	16250-18000	14750-18000	13250-18000
S	**Separated** lane or path	--	--	--	--	--	--

Table 22: Bicycle Compatibility Index - LOS E Matrix

	Facility	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph
N	**Narrow** lane	--	--	13750-18000	12250-16250	10500-14750	10000-13250
W	**Wide** lane	--	--	--	16250-18000	14750-18000	13250-18000
B	**Bike lane** or shoulder	--	--	--	--	--	--
S	**Separated** lane or path	--	--	--	--	--	--

Table 23: Bicycle Compatibility Index - LOS F Matrix

Level of Service Graphs

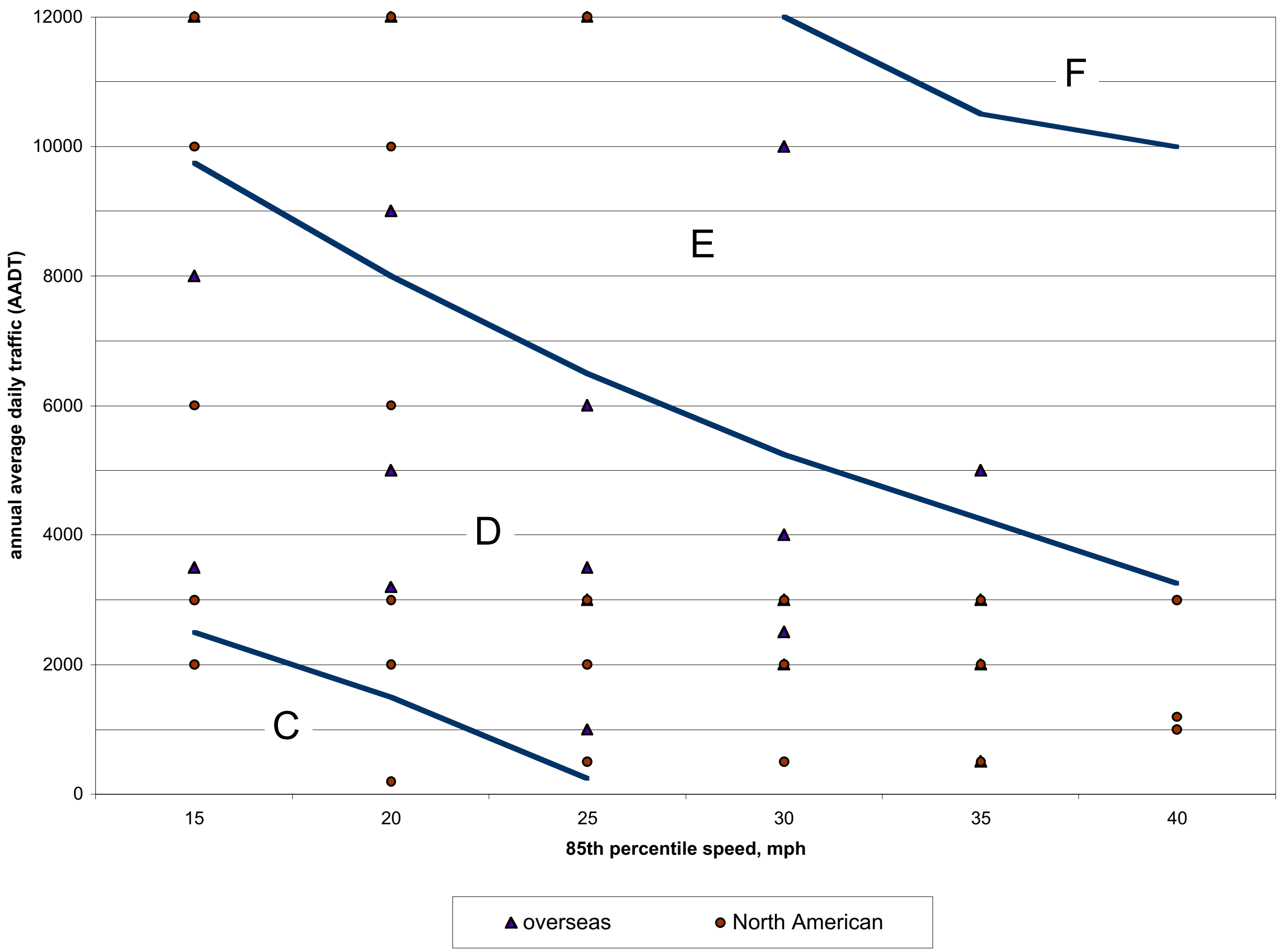

Figure 1: Narrow Lane LOS Graph

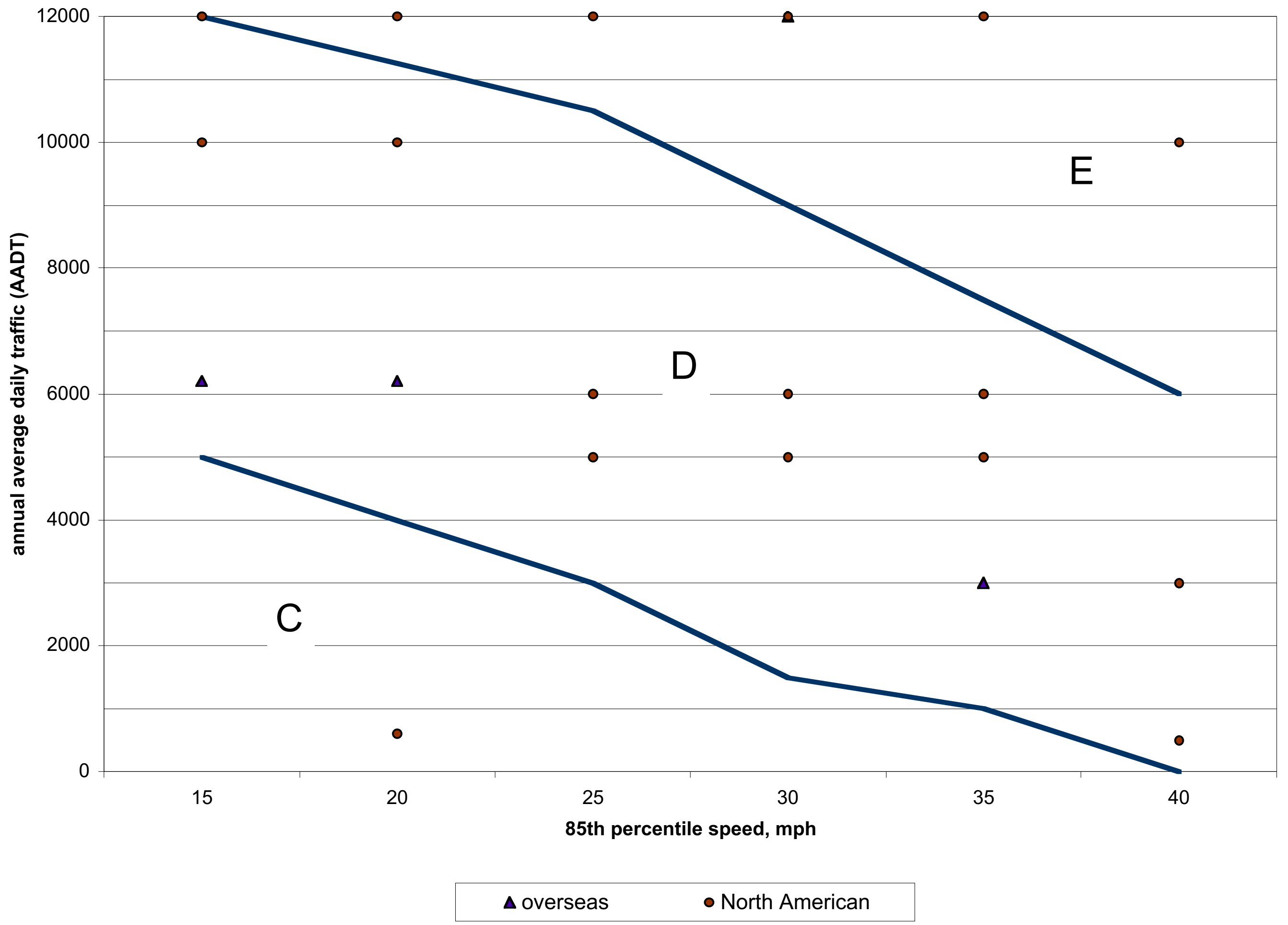

Figure 2: Wide Lane LOS Graph

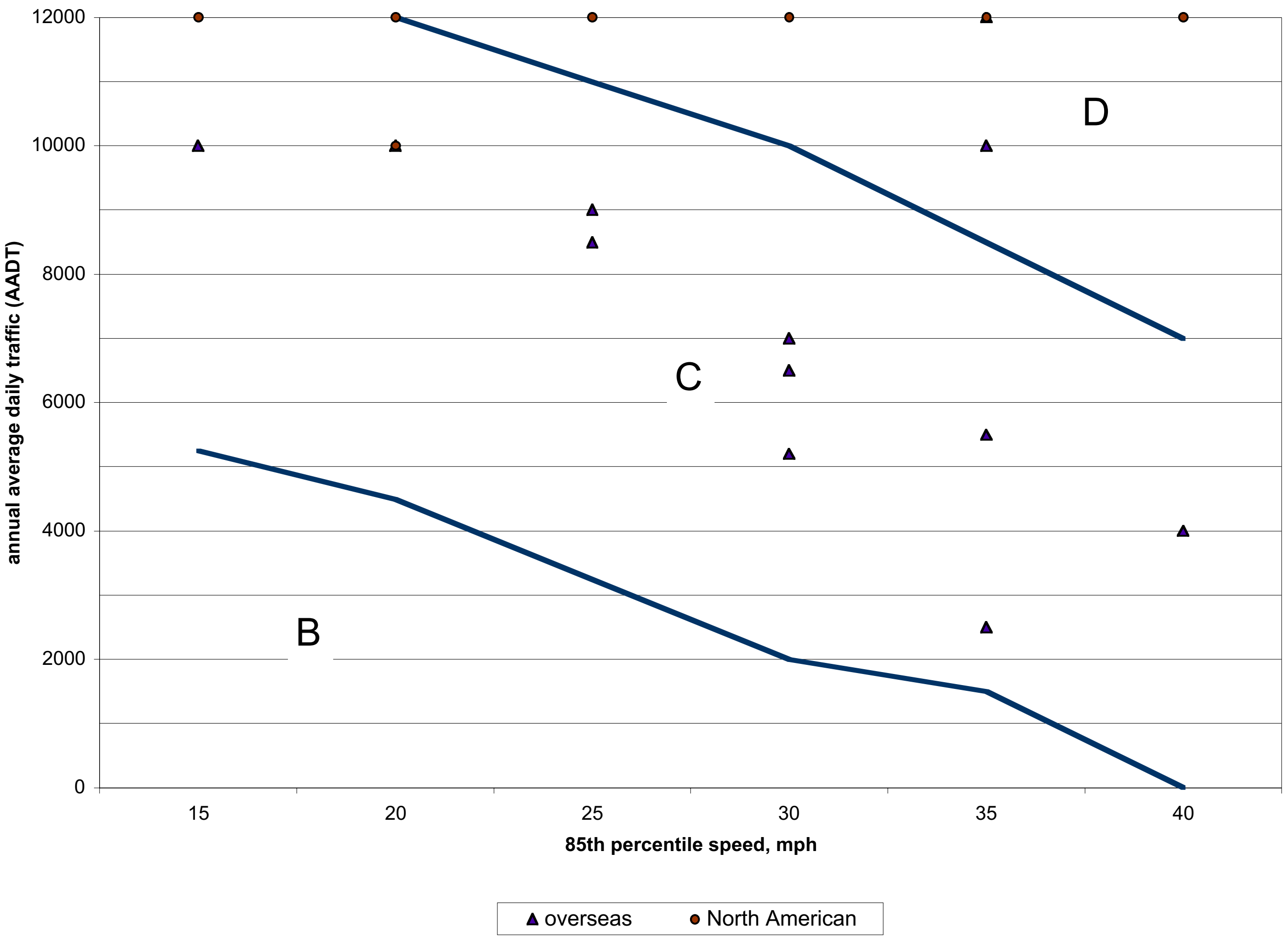

Figure 3: Bike Lane and Shoulder LOS Graph

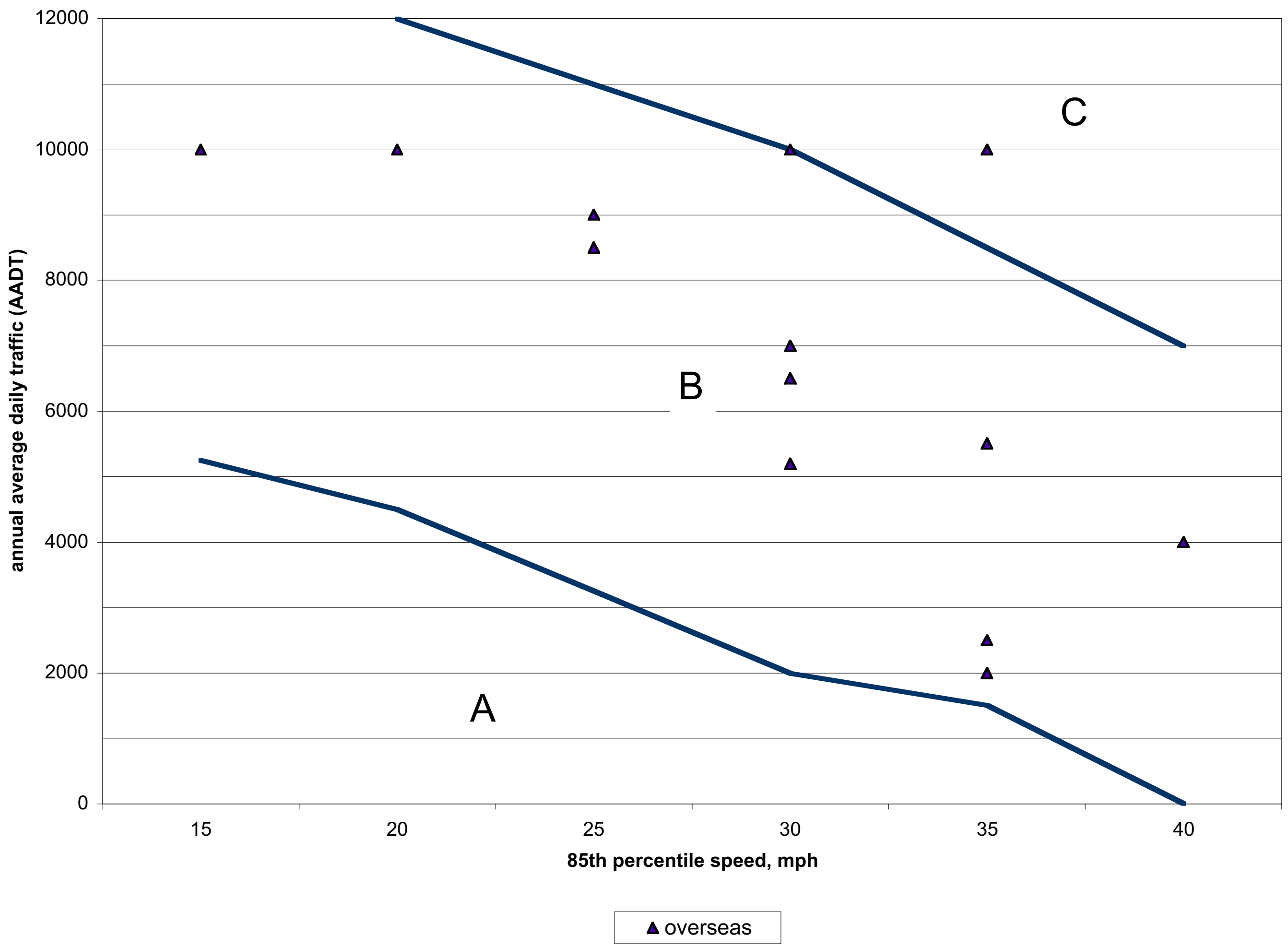

Figure 4: Separated Lane LOS Graph

Speed-Volume Charts

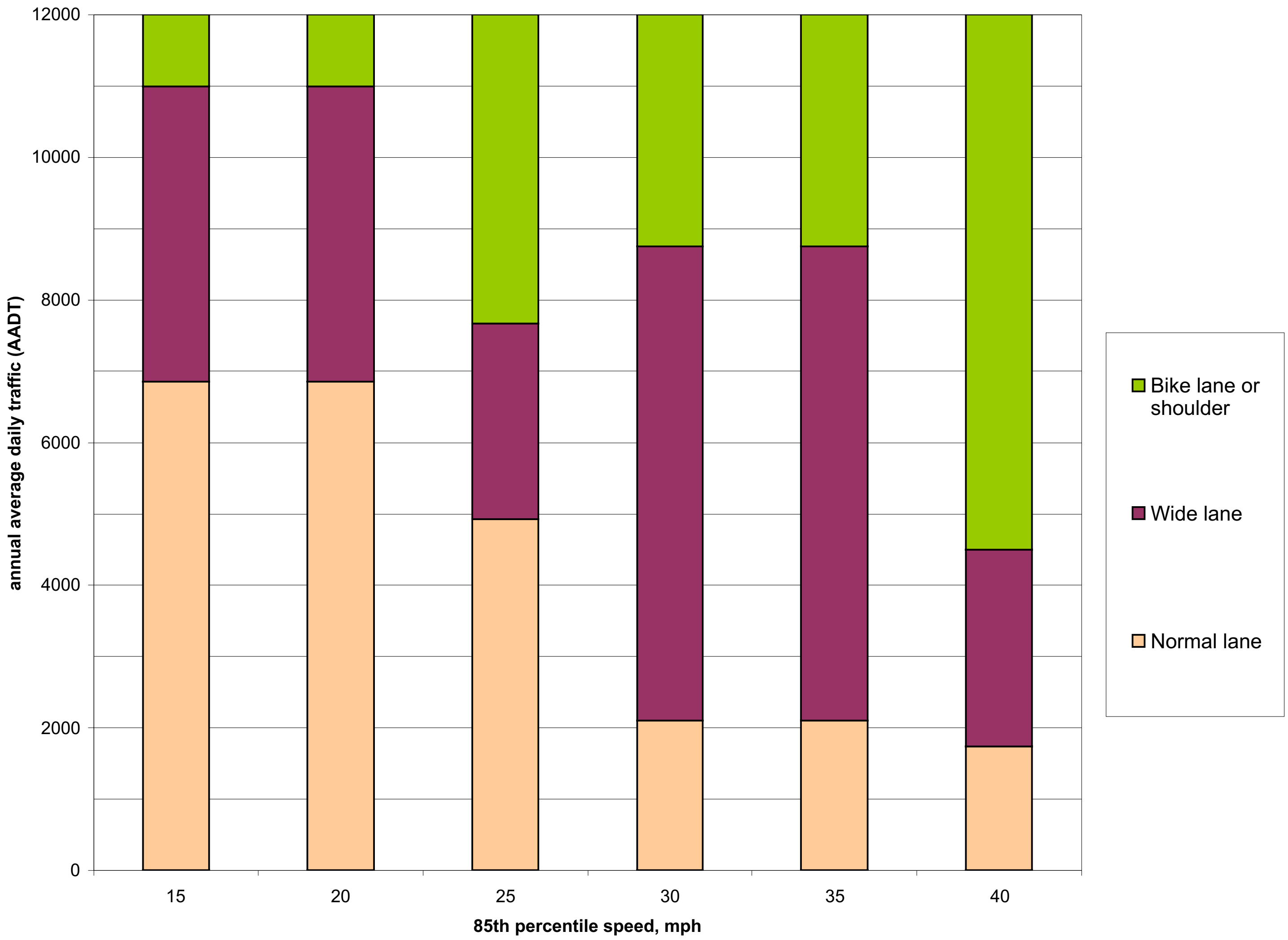

Figure 5: North American Speed-Volume Chart

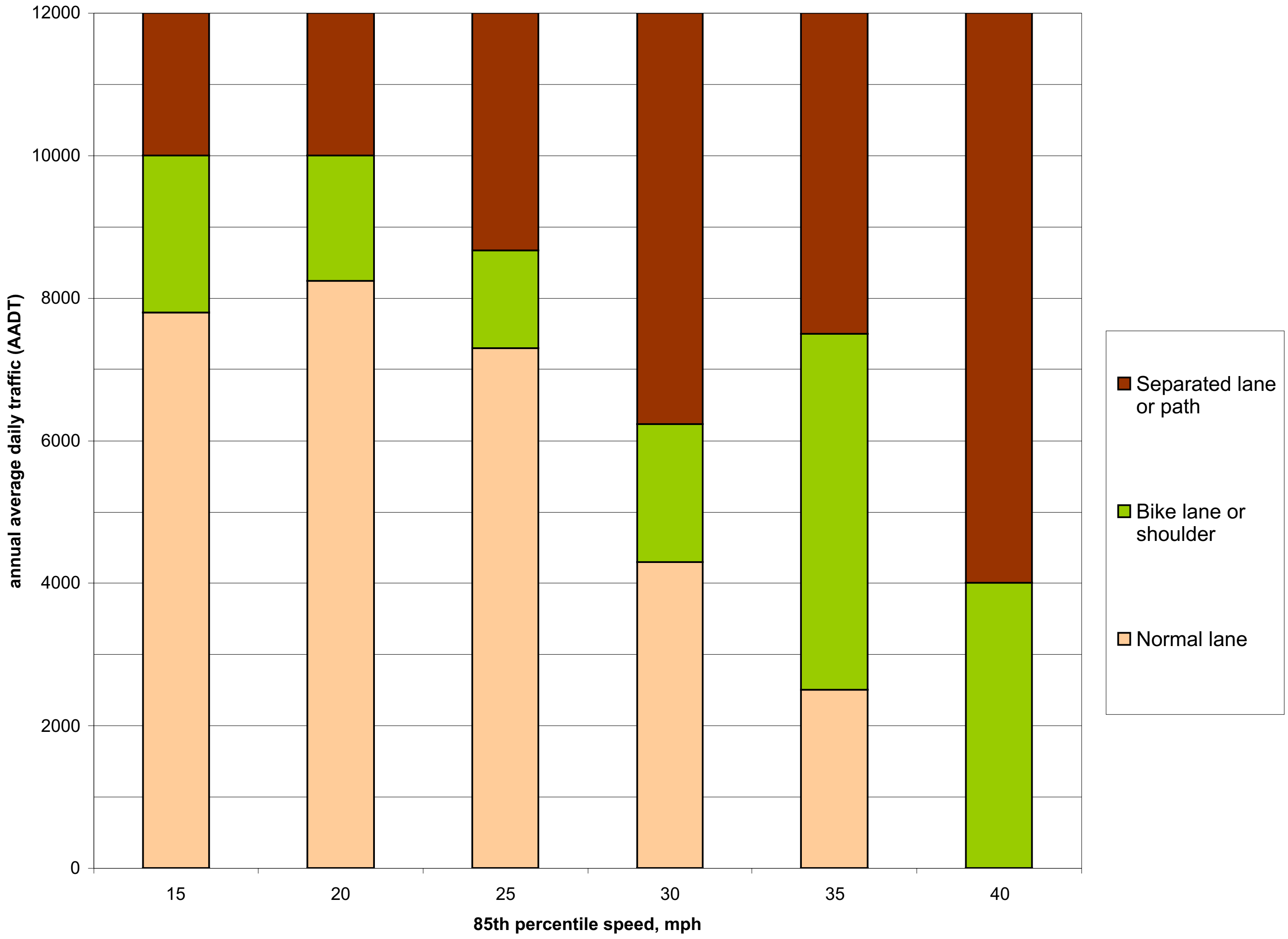

Figure 6: Overseas Speed-Volume Chart

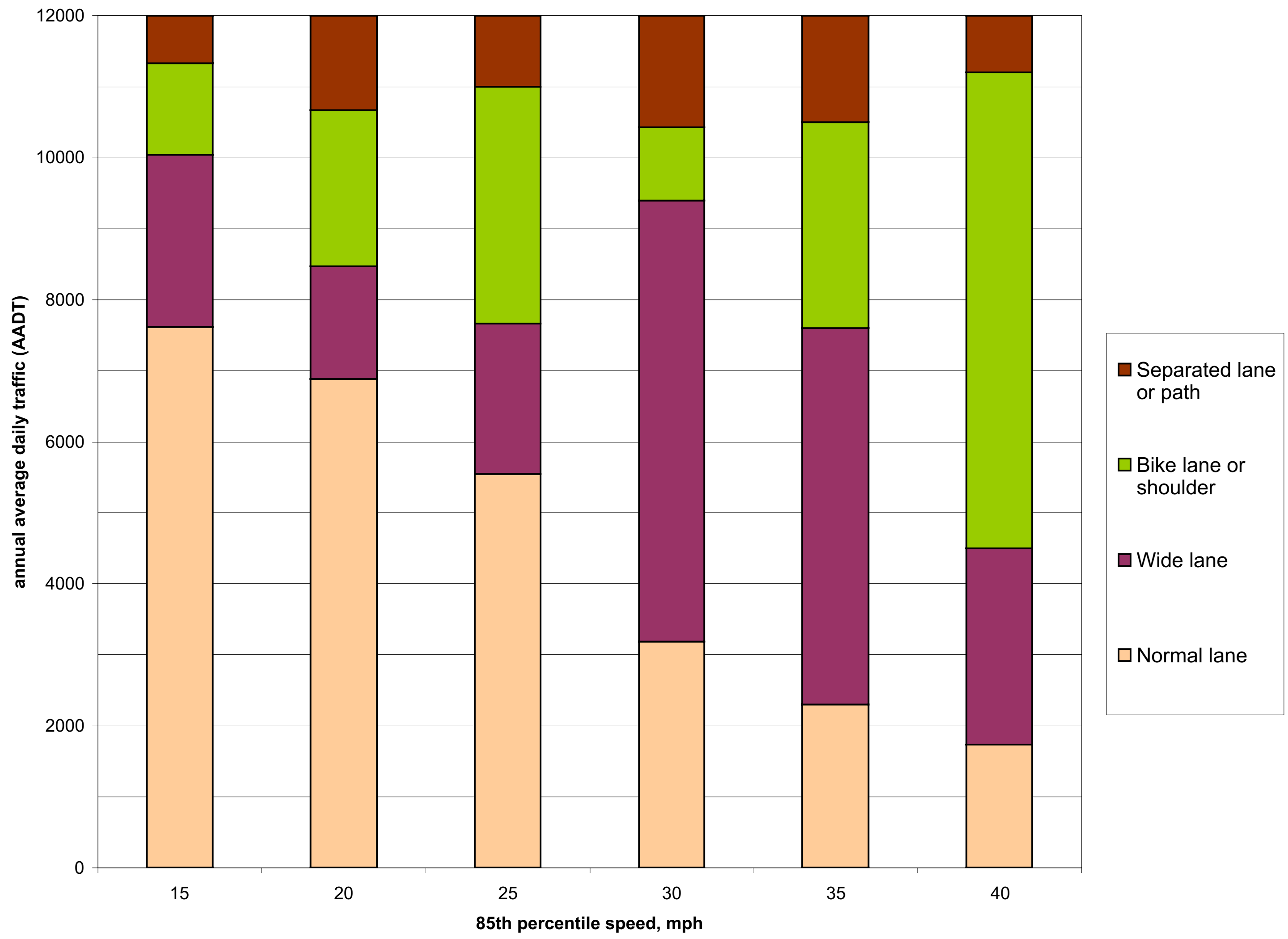

Figure 7: Worldwide Speed-Volume Chart

Narrow Lane Images

Figure 8: Provincetown MA

This narrow commercial street in the heart of Provincetown has one-way vehicle and two-way bicycle traffic. Additionally the sidewalks are discontinuous and narrow, so most people simple walk in the street.

Figure 9: Palo Alto CA

This narrow residential street allows parking on both sides - vehicle speeds are low, and only local traffic uses the street. No special signing or marking is necessary to make this a comfortable street for bicyclists. Credit: Andy Clarke

Figure 10: Sylt, Germany

A typical German bicycle boulevard, or bicycle-priority street. As noted in the street markings the cyclists ride in the center of the roadway and vehicles, by law, may not pass a cyclist.

Figure 11: Heidelberg, Germany

A designated “safe route to school” street with low volumes, low speeds and narrow cross-section.

Figure 12: New Orleans LA

A narrow street through the French Quarter with low speeds and much commercial activity.

Figure 13: Beverungen, Germany

A 12 mph street through the village center with paving stones and gutters between the travel and parking lanes. This street is off the main road and leads to the riverfront..

Wide Lane Images

Figure 14: Saratoga Springs NY

A designated bike route connecting the downtown area to the state park. This sections transitions from a 16-foot wide lane to a 6-lane cross section with mixed traffic.

Figure 15: Palo Alto - Menlo Park CA

The street used to be four lanes, but has been restriped as a a two-lane road with parking, bike lanes and a median with left turn lanes. Credit: Andy Clarke

Bike Lane and Shoulder Images

Figure 16: Coatesville PA

A typical 5-foot wide bike lane along side a (little used) parking lane.

Figure 17: Toronto ON

A typical 4-foot wide bike lane against a curb.

Figure 18: Philadelphia PA

A typical suburban arterial shoulder designated for cycling.

Figure 19: Muenster, Germany

A typical colored bike lane. While there is double striping between the cycle and vehicle lanes, this would not be considered a separated lane.

Separated Lane Images

Figure 20: Madison WI

A wide, high volume bicycle lane through the University district. Although there is physical separation, the lane is wide enough to ride 6-8 feet from the vehicle lane. The lane on the left is a contra-flow lane separated from the vehicle lanes by a median. The street is technically two-way.

Figure 21: New York NY

A typical bike lane in Manhattan created by striping a standard 10-foot vehicle lane. The result is a 5-foot bike lane with 5 feet of separation striping.

Figure 22: Tucson AZ

This bicycle lane has a concrete surface and a brick-surfaced border separates the bike lane from the travel lane. The separation is more visual than physical - motorists and bicyclists can safely cross the brick separator. Credit: Andy Clarke

Figure 23: Dortmund, Germany

This cycle lane is part of the parking lane, yet raised above the roadway surface by a few inches. The red color then differentiates the bike section from the curb, gutter and door opening space. The sidewalk is on the other side of the parked cars.

Figure 24: Ingolstadt, Germany

A typical European ‘cycle track’, raised 2-3 inches above the roadway surface, yet 2-3 inches below the sidewalk surface.

Figure 25: Mainz, Germany

This cycle lane is colored red and has raised markers along the striping. Additionally there are traffic calming features (in this case a pinch point) which serves to slow vehicles but allows cyclists an unimpeded thoroughfare.

Figure 26: Boulder CO

This bike lane through the downtown area is physically separated from the vehicle lanes in certain sections.

Figure 27: Montreal QB

This tw-way bike lane is separated from the vehicle and parking lanes by a small, raised median.

Figure 28: New York NY

This fully separated shared use path along the West Side Highway in Manhattan sees over 1000 cyclists a day – perhaps the largest volume in the United States. It is fully articulated with its own signals, crosswalks, and drainage.

Figure 29: Hong Kong, China

This bikeway (in the far left of the image) runs between a highway and a river. It is fully grade-separated and provides excellent recreational and commuting possibilities.