A Comparison of Advisory Bike Lanes to Bicycle Boulevards, Bicycle Lanes and Yield Roadways using Level of Traffic Stress

An Application of LTS to ABLs

# Abstract

When evaluating which bicycle facility to place on lower volume, lower speed streets, communities are increasingly considering the use of Advisory Bike Lanes (ABLs).

When choosing between facility types, it is helpful to have an “objective” score to inform that decision. In this paper, the Level of Traffic Stress (LTS) metric is chosen for that role. This paper looks at the guidance offered by LTS when choosing between various facility types on low-volume, low-speed streets and any lessons for the design of ABLs which may be drawn from this comparison.

Specifically, this paper compares LTS scores of ABLs to those of bicycle boulevards, standard bicycle lanes and yield roadways on identical streets.

Broadly, ABLs score equal to or better than all of the facilities except in the case of bike lanes at higher speeds. Additionally, ABLs perform better than yield roadways and bicycle boulevards at higher speeds which may indicate a greater resiliency to more stressful street conditions. These findings imply that ABLs offer levels of perceived stress roughly equivalent to the better known facilities used on low-speed, low-volume streets.

With respect to the design of ABLs, two lessons may be drawn. First, the LTS method encourages the use of bike lanes on ABLs which are at least 6’ wide. Second, the LTS method discourages the conversion of ABLs to a short stretch of road with a centerline and shared lane markings on intersection approaches. Extending the ABL markings to the intersection or converting to a short stretch of road with a centerline and bike lanes are encouraged as low stress facilities for intersection approaches.

# Introduction

## Bicycle Facility Metrics

Three well-known metrics used for assessment of bicycle facilities were considered for this paper. They are:

1. Bicycle Compatibility Index (BCI),
2. Bicycle Level of Service (BLOS), and
3. Level of Traffic Stress (LTS).

The BCI method was published by the FHWA in 1998 (FHWA 1998). It addresses only segments. Intersections and their approaches are ignored. BCI stresses the importance of bike lanes and shoulders more than three feet wide. BCI has a linear relationship between its score and a street’s traffic volume. Because BCI imposes a heavy penalty on roads lacking a bike lane or paved shoulder, it is less useful for low volume, low speed streets than other metrics. In addition, BCI has been largely replaced by BLOS and LTS.

The BLOS approach was promulgated by Bruce Landis in 1997 and has been incorporated into the Highway Capacity Manual (Transportation Research Board 2016). In contrast to BCI, BLOS (Landis 1997) uses a logarithmic relationship between traffic volume and its score. Unfortunately, BLOS includes no factors which differentiate between an ABL and a bicycle boulevard placed on the same street.

The LTS system was described by Mekuria in 2012 (Mineta Transportation Institute 2012). LTS is arguably more popular than BCI or BLOS and it has engendered a number of variants in practice and the literature. LTS provides differentiation between ABLs and bicycle boulevards on identical streets so is useful for this work. LTS lacks a direct relationship between traffic volume and its score, using number of lanes and land use type as surrogates for volume. LTS assesses intersections and approaches as well as segments. LTS provides different mechanisms for calculating facility stress depending on whether the street provides a bike lane or requires bicyclists to mix with traffic. From its introduction, LTS has commonly been used as a network-level metric that is used to identify high stress chokepoints connecting lower stress islands. In this paper, LTS is used to evaluate the differences between ABLs and better known facilities for low volume, low speed streets.

# Level of Traffic Stress (LTS)

## Introduction, History, Background

LTS was originally proposed in the Mineta paper (Mineta Transportation Institute 2012) and has become popular since that publication. One advantage is its use of commonly available or easily gathered data.

LTS individually scores the segments, intersection approaches and street crossings on a selected route. LTS employs scores of 1, 2, 3, and 4 with higher values indicating higher levels of stress on a bicyclist in the setting being scored. The highest score for any portion of a route is the LTS score for the entire route.

LTS score values align well with the cyclist typology conceived by Roger Geller (Geller 2005). An LTS score of 1 indicates a facility suitable for all ages. An LTS score of 2 indicates a facility comfortable for adult riders only. LTS scores 1 and 2 are considered to be age subsets of the “interested but concerned” type. An LTS score of 3 indicates a facility which is suitable for “enthused and confident” adult riders and an LTS score of 4 is applied to a facility which is suitable only for the “strong and fearless”.

<<include a figure here relating LTS scores to Geller’s typology, get from original paper>>

# Application of LTS to ABLs

The LTS method does not specifically address ABLs. Its approach classifies bicycle facilities into either mixed traffic (e.g. bicycle boulevards) or bicycle lanes. To road users, ABLs sometimes operate as a mixed traffic facility and sometimes as a standard bike lane. To address this issue, LTS scores are calculated for both cases in all comparisons.

### Segments

The LTS method measures street width in number of lanes. Because the setting being considered is a low-volume, low speed street, this characteristic is always assumed to equal 1 lane in each direction.

In all cases, a residential setting is assumed (this is a factor in the mixed traffic table).

In all cases, a centerline is assumed to be absent. Presence or absence of a centerline is only considered when scoring segments for the mixed traffic case.

Frequency of bike lane blockage, a factor used for scoring bike lanes, is assumed to be rare in all scoring decisions. This removes its impact on facility scores.

Under this set of assumptions, the factors remaining for calculating LTS scores for bicycle lane segments are:

* presence of a parking lane,
* vehicular speed, and
* bicycle lane width.

Under this set of assumptions, the only factor remaining for calculating LTS scores for mixed traffic segments is vehicular speed.

### Intersection Approaches

When applying the LTS method for intersection approaches to ABLs, one must know which intersection treatment is used. Currently, ABL intersection treatments vary among agencies and even within facilities.

Where the intersection is with a minor street or the other street is STOP controlled, the most common treatment is to continue the ABL markings through the intersection, with an added broken edge line. The critical assumption made here with respect to LTS is that no right turn lane has been added at the intersection. Given the low volumes we’re assuming, this is a reasonable assumption. This type of intersection approach is scored as a segment.

When an ABL intersects with a more major street, encounters a STOP sign or a signalized intersection, treatments vary.

One common intersection treatment option is to convert the ABL to a short stretch of road with a double yellow centerline and either shared lane markings or bike lanes. The conversion to a road with a centerline allows scoring with the established LTS method.

When the ABL is converted to a short stretch of road with a centerline and shared lane markings in the travel lanes, the LTS method scores this approach and the attached segment as a mixed traffic facility even if the segment features a bike lane, i.e. the higher stress or score of the mixed traffic approach overrides the stress and score of the portion equipped with a bike lane.

When the ABL is converted to a short stretch of road with a centerline and bike lanes, the LTS method scores this approach as part of the segment unless a right turn lane is added. The critical assumption made here with respect to LTS is that no right turn lane has been added at the intersection. Given the low volumes we’re assuming, this is a reasonable assumption.

Another common treatment is to bring the ABL markings up to the crosswalk markings or where the crosswalk markings would normally be located. This is not a configuration that the LTS model explicitly addresses. The pocket bike lane criterion is not applicable in this case but the criteria for mixed traffic in the presence of right-turn lanes is applicable. If we assume that vehicles turning right from an ABL will merge into the bike lane to initiate their turning movement, this would be equivalent to a single right-turn lane with length less than 75 feet and a curb radius limiting turning speed to 15 MPH. This configuration has no effect on LTS scores. If we assume that vehicles turning right from an ABL stay in the center lane, this approach would be scored the same as the segment.

In all cases but one (the conversion to a short stretch of road with a centerline and shared lane markings), the effect is to score the approach the same as the attached segment. In the case of a conversion to the centerline + shared lane markings, a reduction in score is possible for a segment in which the ABL is being scored as a bike lane. This may be a useful lesson for the design of ABLs.

### Crossings

The LTS scoring for unsignalized crossings uses only the characteristics of the street being crossed. This will be equal for all of the facilities being compared. Unless two ABLs are intersecting (unlikely at this time and ignored herein), there is no need to modify the LTS approach. Signalized crossings were not addressed in the original paper (Mineta Transportation Institute 2012) because “signalized crossings do not usually present a barrier to cycling”.

## ABL Scoring Matrices

Using the assumptions described above, one can form scoring matrices applicable to an ABL.

<< assumptions above would likely mean that some rows or columns in these matrices would go away or be unused?, e.g. blockage in tables 1 & 2, residential in table 3>>

For segments, Table 1 lists the criteria for ABLs next to parking lanes and Table 2 lists the criteria for ABLs not alongside a parking lane. In addition to being used for segments, these tables are used for intersection approaches which consist of a conversion of the ABL to a street with a centerline and bike lanes.

Table 3 is an excerpt of Table 4 from the original paper (Mineta Transportation Institute 2012). Scoring for streets with more than three lanes is excised and consideration of the presence of a centerline is removed. It lists the criteria for mixed traffic for streets with 2-3 lanes. This matrix is only used when an ABL’s intersection approach consists of the conversion of the ABL to a street with a centerline and shared lane markings.

Tables 4 and 5 are included for completeness. They are unaltered copies of Tables 7 and 8 from the original paper (Mineta Transportation Institute 2012) because the score is dependent only on the characteristics of the street being crossed.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 1. Criteria for ABL Alongside a Parking Lane** | | | | |
|  | LTS >= 1 | LTS >= 2 | LTS >= 3 | LTS >= 4 |
| Sum of bike lane and parking lane width (includes marked buffer and paved gutter) | 15 feet or more | 14 or 14.5 feeta | 13.5 feet or less | (no effect) |
| Speed limit or prevailing speed | <= 25 MPH | 30 MPH | 35 MPH | N/A |
| Bike lane blockage | Rare | (no effect) | Frequent | (no effect) |

Note: (no effect) = factor does not trigger an increase to this level of traffic stress

a If speed limit < 25 MPH or Class = residential, then any width is acceptable for LTS 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 2. Criteria for ABL Not Alongside a Parking Lane** | | | | |
|  | LTS >= 1 | LTS >= 2 | LTS >= 3 | LTS >= 4 |
| Bike lane width (includes marked buffer and paved gutter) | 6 feet or more | 5.5 feet or less | (no effect) | (no effect) |
| Speed limit or prevailing speed | <= 30 MPH | (no effect) | 35 MPH | N/A |
| Bike lane blockage | Rare | (no effect) | Frequent | (no effect) |

Note: (no effect) = factor does not trigger an increase to this level of traffic stress

|  |  |
| --- | --- |
| **Table 3. Criteria for Level of Traffic Stress in Mixed Traffic** | |
| Speed limit up to 25 MPH | LTS 1a or 2a |
| 30 MPH | LTS 2a or 3a |
| 35 MPH and above | LTS 4 |

Note: a Use lower value for streets classified as residential; use higher value otherwise.

This table is also used for scoring an intersection approach which consists of an ABL converted to shared lane markings and a centerline.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 4. Level of Traffic Stress Criteria for Unsignalized Crossings Without a Median Refuge** | | | |
| **Speed Limit of Street Being Crossed** | **Width of Street Being Crossed** | | |
| **Up to 3 lanes** | **4-5 lanes** | **6+ lanes** |
| Up to 25 MPH | LTS 1 | LTS 2 | LTS 4 |
| 30 MPH | LTS 1 | LTS 2 | LTS 4 |
| 35 MPH | LTS 2 | LTS 3 | LTS 4 |
| 40+ MPH | LTS 3 | LTS 4 | LTS 4 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 5. Level of Traffic Stress Criteria for Unsignalized Crossings With a Median Refuge at Least Six Feet Wide** | | | |
| **Speed Limit of Street Being Crossed** | **Width of Street Being Crossed** | | |
| **Up to 3 lanes** | **4-5 lanes** | **6+ lanes** |
| Up to 25 MPH | LTS 1 | LTS 1 | LTS 2 |
| 30 MPH | LTS 1 | LTS 2 | LTS 3 |
| 35 MPH | LTS 2 | LTS 3 | LTS 4 |
| 40+ MPH | LTS 3 | LTS 4 | LTS 4 |

## Discussion of LTS as applied to ABLs

By examining only the matrices for segment and approach scoring, we can make some observations.

First, the characteristics of an ABL reduce the number of factors which contribute to an LTS score. As a result, LTS is strongly correlated to speed. Ignoring the bike lane blockage factor,

1. All ABLs with a speed of 25 MPH, LTS = 1 or 2,
2. All ABLs with a speed of 30 MPH, LTS = 2 or 3, and
3. All ABLs with a speed of 35 MPH, LTS = 3 or 4.

Second, usable bike lane widths of six feet or greater make LTS = 1 easy to achieve. Wide bike lanes are easily achieved in ABLs because widening the bike lane does not remove width available for vehicular use as it does in standard bike lanes.

Third, converting an ABL at an intersection approach to a road with a centerline and shared lane markings can raise the LTS score by 1. Bringing the ABL markings up to the intersection or converting the ABL to a street with a centerline and standard bike lanes, avoids this increase. Whether the LTS scores attached to these three options accurately reflects the stress experienced by most riders is debatable.

Fourth, for a low-stress network, ABLs with speeds of 25 MPH or less and usable bike lane widths of six feet or more can create appropriate facilities.

LTS must be used with knowledge of its limitations. Because LTS uses number of lanes and surrounding land use as surrogates for vehicular volumes, it can provide similar scores for facilities with different levels of perceived stress. An ABL with an LTS score of 1 on a street with less than 1,000 ADT could qualify as a facility appropriate for all ages and abilities. An ABL with LTS score of 1 on a street with 5,000 ADT and high parking lane turnover is certainly not appropriate for all ages and abilities.

# Comparison of ABLs to Other Facilities

Having described an approach for applying the LTS method to ABLs, the next step is to use that tool to compare ABLs to other facility types commonly considered for low volume, low speed streets. The conditions under which comparison of facilities is done will of necessity be limited by the facility type with the most restrictive siting conditions.

Facilities commonly considered for these conditions include bicycle boulevards, yield roadways, and bike lanes. Shared lane markings are not explicitly compared to ABLs because they are commonly used within bicycle boulevards; the score received by a bicycle boulevard under LTS is the same as the score received by a shared lane marking treatment. Woonerfs, home zones and similar facilities are not included in this paper because they are not intended for use on streets which support through vehicular traffic.

This paper separates these treatments in order to compare them. The reality is not so clear cut. For example, all of the traffic calming and diversion techniques which commonly used for bicycle boulevards can also be used for ABLs, or any of the other treatments. Indeed, one could use an ABL configuration within a bicycle boulevard. Such a facility might be useful for a street with high asymmetric peak vehicular volumes and reasonable bicycle volumes, such as a street with a commute-dominated profile, i.e. high vehicular flows in opposite directions in the morning and evening with little flow otherwise.

## Comparison of ABLs to Bicycle Boulevards

In order to compare the LTS scores of ABLs and bicycle boulevards, one must make some assumptions. For this comparison, it is assumed that the designer has taken advantage of the ABL’s ability to include wide bike lanes and the traffic calming effect of a narrow center lane. The assumption is made that the bike lane is always so wide as to not increase the LTS score, i.e. 15’ of more when next to a parking lane or 6’ or more when not next to a parking lane. Given the characteristics of a street suitable for a bicycle boulevard, bike lane blockage is assumed to be rare. Siting of bicycle boulevards is assumed to be on streets of 25 MPH or less and vehicle volumes less than 3,000 ADT. This reflects recent FHWA guidance (Federal Highway Administration 2016). It should be noted that some communities have adopted more restrictive guidelines in order to create a facility which is truly appropriate for all ages and abilities.

Case 1: LTS Scores when ABL classified as Bike Lane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **With Parking Lane** | | | **Without Parking Lane** | | |
| **Speed (MPH)** | **25** | **30** | **35** | **25** | **30** | **35** |
| **ABL** | 1 | 2 | 3 | 1 | **1** | **3** |
| **Bicycle Boulevard** | 1 | 2 | 4 | 1 | **2** | **4** |

The cells which are hatched and colored are for speeds that are not normally considered for bicycle boulevards. At most, the information in these cells indicate how the two facilities fare as conditions degrade.

Case 2: LTS Scores when ABL classified as Mixed Traffic

Because bicycle boulevards are classified as mixed traffic in the LTS method, the scores for both facilities are equal in equivalent conditions.

When both facilities are classified as mixed traffic, their scores are equal. When ABLs are classified as bike lanes, ABLs and bicycle boulevards are both scored as 1, within the realm of street conditions suitable for a bicycle boulevard. Outside of this realm, ABL scores are either equal or better than the bicycle boulevard scores. This reflects the inherent advantage the LTS method gives to bike lanes as speeds increase but may also indicate an ability of ABLs to provide more comfortable infrastructure as speeds increase.

## Comparison of ABLs to Yield Roadways

In order to compare the LTS scores of ABLs and yield roadways, one must make some assumptions. The first assumption is that the paved street is wide enough to support the operation and markings of an ABL. Some streets on which a yield roadway approach is considered are of substandard width or include portions with poor pavement conditions. Paved widths of less than approximately 20 feet could preclude the consideration of ABLs and pavement unable to support consistent, visible markings could degrade the markings to the point where an ABL would be ill-advised. The designer is assumed to have taken advantage of the ABL’s ability to accommodate wide bike lanes and the traffic calming effect of a narrow center lane. The assumption is made that the bike lane is always so wide as to not increase the LTS score, i.e. 15’ of more when next to a parking lane or 6’ or more when not next to a parking lane. In contrast to the bicycle boulevard case, bike lane blockage could be more common if poor shoulder conditions encourage parking in the bike lane. For the purposes of this comparison, bike lane blockage is assumed to be rare. Siting of yield roadways is assumed to be on streets of 30 MPH or less and vehicle volumes less than 2,000 ADT which reflects recent FHWA guidance (Federal Highway Administration 2016).

Case 1: LTS Scores when ABL classified as Bike Lane

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **With Parking Lane** | | | **Without Parking Lane** | | |
| **Speed (MPH)** | **25** | **30** | **35** | **25** | **30** | **35** |
| **ABL** | 1 | 2 | 3 | 1 | 1 | 3 |
| **Yield Roadway** | 1 | 2 | 4 | 1 | 2 | 4 |

The cells which are hatched and colored are for speeds that are not normally considered for yield roadways. At most, the information in these cells indicate how the two facilities fare as conditions degrade.

Case 2: LTS Scores when ABL classified as Mixed Traffic

Because yield roadways are classified as mixed traffic in the LTS method, the LTS scores for both facilities are equal in equivalent conditions.

When both facilities are classified as mixed traffic, their scores are equal. With one exception, when ABLs are classified as bike lanes, ABLs and yield roadways receive equal scores within the realm of street conditions suitable for a yield roadway. The one exception occurs when prevailing speeds are 30 MPH and the street lacks a parking lane. In this case, the ABL receives a better score. Outside of the conditions suitable for a yield roadway, ABL scores are either equal or better than the yield roadway scores. This reflects the inherent advantage the LTS method gives to bike lanes as speeds increase but may also indicate an ability of ABLs to provide more comfortable infrastructure as speeds increase.

## Comparison of ABLs to Bicycle Lanes

In order to compare the LTS scores of ABLs and standard bike lanes, one must make some assumptions. The designer is assumed to have taken advantage of the ABL’s ability to accommodate wide bike lanes and the traffic calming effect of a narrow center lane. The assumption is made that the bike lane is always so wide as to not increase the LTS score, i.e. 15’ of more when next to a parking lane or 6’ or more when not alongside a parking lane. The bike lane blockage factor will affect both facility’s scores equally and is assumed to be rare for both facilities for that reason. In contrast to the bicycle boulevard and yield roadway examples, the ABL possesses the limiting siting conditions in this comparison. Current FHWA guidance (Federal Highway Administration 2016) claims ABLs are appropriate for streets with up to 6,000 ADT and up to 35 MPH posted speed limits.

Case 1: LTS Scores when ABL classified as Bike Lane

When ABLs are classified as bike lanes, both facilities receive equal scores in all conditions with one exception. If an intersection approach for an ABL consists of a conversion to a street with a centerline and shared lane markings, this results in the approach being scored as a mixed traffic facility, which is considered in Case 2 below.

A notable advantage of ABLs over traditional bike lanes is their ability to provide wider bike lanes without the need for additional roadway width. This could result in a lower LTS score for an ABL than a standard bike lane on an equivalent road. This occurs when a road is wide enough to allow standard bike lanes but not wide enough to allow those bike lanes to be at least six feet wide. This ability becomes more important to bicyclists’ perception of stress if the bike lanes are placed alongside a parking lane.

Case 2: LTS Scores when ABL classified as Mixed Traffic

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **With Parking Lane** | | | **Without Parking Lane** | | |
| **Speed (MPH)** | **25** | **30** | **35** | **25** | **30** | **35** |
| **ABL** | 1 | 2 | 4 | 1 | 2 | 4 |
| **Bicycle Lane** | 1 | 2 | 3 | 1 | 1 | 3 |

When ABLs are classified as bicycle lanes, the two facilities always receive equal scores with two possible exceptions. The first exception is when an ABL is converted to a short stretch of road with a centerline and shared lane markings on an intersection approach. The second exception is when the available road width allows ABLs to provide bike lanes of six foot or greater width but restricts standard bike lanes to widths of less than six feet.

When ABLs are classified as mixed traffic, they receive a higher LTS score at 35 MPH when alongside a parking lane and higher scores at speeds of 30 MPH and greater when not alongside a parking lane.

# Discussion

ABLs and bicycle boulevards receive the same LTS score when placed on the same street. This is true whether an ABL is classified as a mixed traffic or a standard bicycle lane treatment. This is primarily due to the siting conditions for bicycle boulevards which require a calm street. At speeds above normal siting requirements for bicycle boulevards, ABLs receive equal or better scores. The maximum difference between ABL and bicycle boulevard scores is 1.

When comparing ABLs to yield roadways on equivalent streets, ABLs receive equal scores when classified as mixed traffic facilities. When ABLs are classified as bike lanes, they receive equal or better scores. At 35 MPH, just above normal siting conditions, ABLs receive a better score when classified as bike lanes. The maximum difference between ABL and yield roadway scores is 1.

When comparing ABLs to standard bicycle lanes on equivalent streets, ABLs receive equal scores when classified as bike lanes, except when an ABL intersection approach is converted to a configuration which includes a centerline and shared lane markings. When ABLs are classified as mixed traffic with parking lanes, they receive equal scores until 35 MPH at which point standard bike lanes fare better. When ABLs are classified as mixed traffic without parking lanes, they receive equal scores until 30 MPH at which point standard bike lanes fare better. The maximum difference between ABL and standard bicycle lane scores is 1.

# Conclusion

There are caveats to acknowledge with the use of LTS as a bicycle facility comparison tool. First, LTS is normally applied at the network level as a tool for identifying high stress areas in a low stress network. LTS was not intended to be a tool for directly comparing facility types though one could argue that LTS performs its network-level work by comparing facility types. Second, by restricting these comparisons to the conditions which the facility with the most restrictive siting conditions requires, a significant portion of the LTS scoring dynamic range is lost. Most of the scores used for comparison in this work are at LTS levels 1 and 2. Scores of 3 and 4 often occur outside of the conditions used for comparison and may have little meaning. By restricting scores to the lower half of the LTS range, it is difficult to make fine-grained comparisons. Given these caveats, it is still possible to draw some conclusions.

One can conclude that ABLs are roughly equal to bicycle boulevards, yield roadways and bicycle lanes in perceived stress when used in appropriate conditions. The exception to this statement may be the lower scores received by standard bicycle lanes on higher speed streets.

In addition, ABLs maintain their low LTS scores on streets with higher prevailing speeds than those normally considered for bicycle boulevards and yield roadways. This may indicate an ability for ABLs to provide lower stress on less-welcoming streets or to provide lower stress as conditions on an existing facility deteriorate.

The application of LTS to ABLs does provide some lessons for the design of ABLs. With respect to bicycle lane width, the LTS criteria require that bicycle lanes be six feet or more in width when not alongside a parking lane or fifteen feet or more in width when alongside a parking lane to attain the lowest LTS score, other factors notwithstanding. The use of bicycle lanes of six feet width or more helps protect bicyclists from threats originating in the parking lane such as dooring incidents or moving vehicles. Wide bicycle lanes also allow safe side-by-side riding and safe bicycle-bicycle passing. In addition, wide bicycle lanes enhance the traffic calming effect of an ABL by narrowing the center lane. The use of bicycle lanes six feet or greater in width should be the default option for any ABL, assuming sufficient space is available.

With respect to intersection treatments, the LTS method penalizes an ABL for transitioning to a street with a centerline and shared lane markings at the approach to an intersection when the ABL is classified as a bicycle lane. Transitioning to a street with a centerline and standard bicycle lanes would avoid that penalty but space for that strategy may not be available. Another option for avoiding this penalty is to maintain the ABL markings up to the crosswalk or where the crosswalk markings would normally be located. This strategy requires no additional right-of-way but may cause problems for drivers unfamiliar with ABLs. Vehicles stopped in the middle of the center lane at an intersection could create difficulties for motorists attempting to enter the ABL-equipped street. An easy solution to that problem is to add a centerline at the intersection but that takes one back to use of either standard bike lanes or shared lane markings. It isn’t clear whether the introduction of a centerline and shared lane markings at an intersection’s approach is markedly more stressful than the preceding ABL on a segment. Vehicles are traveling more slowly near an intersection so shared lane markings for this short stretch may be perceived as similarly comfortable as an ABL on a segment.

An ABL’s ability to provide wide bicycle lanes is their major advantage when compared to standard bicycle lanes. ABLs can provide wide bicycle lanes without reducing the road width available to motor vehicles; this is something standard bicycle lanes are unable to do. These wider lanes can provide protection from dooring incidents and increase horizontal separation during motor vehicle-bicycle passing operations. But the ability to provide wide bicycle lanes comes at the cost of allowing motor vehicle encroachment into those bicycle lanes.

One obvious difference between ABLs and bike boulevards not wholly addressed by the LTS approach is the guidance on horizontal position of bicyclists provided by the two treatments. An ABL directs bicyclists to position themselves in the bicycle lane. A bicycle boulevard directs bicyclists to position themselves virtually anywhere in the right half of the street; when shared lane markings are present, they normally position the bicyclist in the middle of the travel lane. Positioning bicyclists in the middle of the travel lane, as bicycle boulevards do, should increase protection from vehicles and activities originating in the parking lane. ABLs designed with wide bicycle lanes and hatching to denote dooring zones would allow ABLs to approach this level of protection.

With respect to bicycle boulevards and yield roadways, it can be argued that ABLs provide greater protection for bicyclists from motor vehicles in the travel lane. By providing separate areas which are preferentially used by motor vehicles and non-motorized users, predictability of position and movement is increased and modal separation should be improved. This latter prediction is not supported by the studies provided so far which show a small reduction in horizontal separation between motor vehicles and bicycles on ABL-equipped roads which had replaced standard two lane roads <<reference the 2 Dutch studies here and Danish>>.

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