The Capital Area MPO

Bicycle Facility Planning and Engineering Guidelines

Adopted by the N.C. Capital Area MPO
Technical Coordinating Committee February 02, 2006

Adopted by the N.C. Capital Area MPO
Transportation Advisory Committee February 15, 2006

Table of Contents

CAMPO Bicycle Facility Planning and Engineering Guidelines

Staff Introduction by Jake Petrosky
September 27, 2005

On January 25th, 2005 the Capital Area MPO Bicycle and Pedestrian Stakeholders Group (BPSG) voted to make their top priority, "the identification of best practices and engineering for facility improvements related to walking and cycling." During subsequent meetings the group reviewed existing design guidelines from a number of sources, including NCDOT, FHWA, and APA. After much research it was concluded that the North Carolina Bicycle Facilities Planning and Design Guidelines, an NCDOT publication, was the most comprehensive resource for design standards and engineering guidance related to bicycle facilities. NCDOT's website included several shorter documents providing an overview of the types of bicycle facilities @ www.ncdot.org/transit/bicycle/projects/project_types/bpt_intro.html. The BPSG reviewed these documents and decided that while providing a laudable description of facility types, these documents failed to give proper guidance as to when certain types of bicycle accommodations should be employed. Accordingly, the BPSG elected to create guidelines similar to the overview documents NCDOT distributes via their website, but enhanced to give local planners and citizens a more complete look at the benefits and drawbacks of certain types of bicycle facilities. These guidelines will serve as the narrative portion of the bicycle element of the Wake County Comprehensive Transportation Plan. In general, the CAMPO Bicycle Facility Planning and Engineering Guidelines can be consulted by local planners and citizens when they are called on to determine the appropriateness of one bicycle facility type versus another.

The Capital Area MPO Bicycle and Pedestrian Stakeholders Group voted to approve the guidelines and forward them for TCC approval on November 1st, 2005. When approved, the document will serve as a useful reference for member governments when designing bicycle facilities and during the development of bicycle plans.

ROADWAYS

DEFINITION

Roadways are the most frequently used bicycle facility, because cities, towns, and rural areas alike have been built in a vehicle-oriented fashion. Virtually every destination has a street address and is accessible via a road publicly or privately maintained. In some communities, "greenways" or "multi-use paths" in an independent right-of-way offer an alternative to road travel for some trips. In most areas, however, roadways are the only viable route for bicyclists to reach their destination.

This photo illustrates a typical roadway in the Triangle. NC State law requires that motor vehicles and bicycles share the road.

Location: NC 55 South of US 1

North Carolina state law recognizes a bicyclist's right to the road by defining bicycles as vehicles. Accordingly roadways should be designed, constructed, and maintained for both bicycle and motor vehicle travel.

In most cases, paved roadways designed for motor vehicles are structurally adequate for bicycles. However, there are some subtle details that can make roadways more safe, comfortable, or efficient for bicyclists and motor vehicle drivers. These include:

- Surface conditions that are compatible with bicycle tires
- Traffic signals that respond to bicycles
- Consideration of low-speed traffic in junction design
- Cross-sections that allow easier passing of slower vehicles by faster vehicles on busy roads

PLANNING AND DESIGN CONSIDERATIONS

Surfaces

- The surfaces of travel lanes should be designed and maintained to accommodate typical road bicycles. Because bicycles are two-wheeled vehicles and have very narrow tires, care must be taken to avoid creating conditions that cause tire punctures or bicycle instability.

- Drainage grates should be kept out of the travel lane. Drainage grates near or in the travel lane should be level with the roadway surface and have slots oriented across, not parallel to, the path of bicycle travel. Similarly, railway crossings should be as close to a right angle as possible. Bicycle tires can become stuck in parallel slots, causing the cyclist to fall.

- Travel lane pavement level should be kept as flush with the gutter as possible. When bicycle tires strike them laterally, the seam created by uneven pavement-gutter joints can cause bicycles to tip over and crash.

- Pavement should be kept as free as possible of potholes, seams parallel to the direction of travel, and debris. Smooth paving techniques should be utilized. All of these defects can cause punctures or blowouts in bicycle tires, which are far narrower and thinner than car tires. Seams can cause instability and lead to crashes.

- Chip-and-seal paving, rumble strips, cobblestones, and other rough surfaces should be avoided. These surfaces lead to a very rough ride and can case tire damage.

Junctions

- Demand-actuated traffic signals should be designed and calibrated to detect bicycles.
- High-speed right-turn only lanes and high-speed slip or merge lanes should be avoided on roadways that are not fully controlled access. If such lanes are necessary for capacity, they should be designed for speeds compatible with merging into a mixed-traffic environment including bicycles in the roadway and pedestrians at crosswalks.

Cross Sections

- On important roadways where typical traffic volumes and speeds may make it desirable to facilitate easier passing of slower vehicles, additional pavement width in the form of wider outside through lanes, wide paved shoulders, or bike lanes should be considered.

- Travel lane width should be reasonably consistent along a route. Lane width should not fluctuate frequently between widths that encourage same-lane passing of cyclists and widths that are too narrow to facilitate this safely. Chicanes and other spot-narrowing street designs should be avoided.

Street Topology

- Roads should be well-connected and redundant, providing multiple potential routes between trip endpoints and allowing cyclists to avoid major arterial roads. Local street layouts should be direct enough to make short trips efficient.

- Municipalities should encourage a "grid" network of streets in order reduce trip time and length while reducing congestion during rush hour and emergency situations.

WIDE OUTSIDE LANES

Wide outside lanes allow motorists to pass slower moving bicyclists safely without changing lanes. This results in a safer roadway for both cyclists and motorists.

Location: Cary Parkway @ James Jackson
Source: NCDOT

DEFINITION

A wide outside lane (or wide curb lane) refers to the right-most through lane. By North Carolina state law, bicyclists are allowed on all non-freeway roadways. Although wide outside lanes may increase a cyclist's sense of safety and encourage cycling, wide outside lanes are mainly for the convenience of motor vehicle operators, who can pass a cyclist without entering the adjacent lane. Dedicated right-turn-only lanes are not used for wide outside lanes. Where right turn lanes exist, the wide outside lane should continue to the left of the right turn only lanes.

Two ways to obtain widened outside lanes are:

1. Differential striping on an existing road: when existing multi-lane roadways are being re-surfaced, the inside lanes can be narrowed to provide extra space for widening the outside lane; bicyclists and motorists can operate in the same lane. This type of treatment is a non-construction alternative.

2. Widened outside lanes as a part of roadway improvement projects. New roadways can have additional width provided in the outside lane as a part of the overall roadway construction project.

WHEN TO CONSIDER THIS TYPE OF FACILITY

A widened outside lane is an effective way to accommodate motor vehicles passing in the same lane as bicyclists. With a wide outside lane, motorists do not have to change lanes to pass a bicyclist. The additional width in the outside lane also improves sight distance and provides more room for vehicles to turn onto the roadway. Therefore, on roadways with bicycle traffic, widening the outside lane can improve the capacity of that roadway. Also, by widening the outside lane by a few extra feet both motorists and bicyclists have more space in which to maneuver.

PRINCIPAL PLANNING CONCERNS WITH WIDE OUTSIDE LANES

- It is recommended that municipal engineering standards require that all newly constructed or improved arterials, thoroughfares, and collectors include wide outside lanes in their design. This provides motorists with adequate room to pass cyclists without conflicting with motor vehicles in adjacent lanes or passing cyclists too closely.

- This facility type is generally considered for use in urban, suburban, and occasionally rural conditions on roadways where volumes necessitate an improved passing facility.

- Relative to paved shoulders, wide outside lanes require less sweeping because motor vehicles using the outer portion of the lane (when cyclists are not present) blow debris to the far right of the roadway.

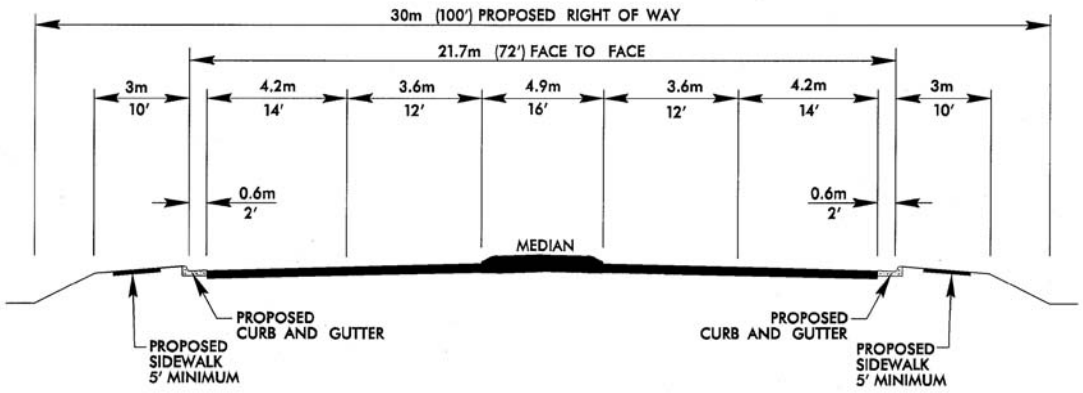
PLANNING AND DESIGN CONSIDERATIONS

On new arterial or collector roadways the standard motor vehicle lane width is 3.6m (12 ft). The AASHTO standard lane width to accommodate both motorists and bicyclists should be 4.2m (14 ft). If an existing multi-lane roadway with standard 3.6m lanes cannot be widened to accommodate 4.2m outside lanes, then the inside lanes can be narrowed to 3.3m (11ft.), thus providing extra width for 3.9m (13 ft) wide outside lanes. On roads with opposite-direction traffic in the adjacent lane and on roads with higher ADT, higher average speeds, and /or higher volumes of truck or bus traffic, 15-16 feet is preferable. This provides the same total passing space as a standard 12’ travel lane next to a minimum-width bike lane, but without the stripe. On roads with on street parking, 15-16 feet wide outside lanes are recommended in order to allow cyclists to operate safely outside of the "door zone" while simultaneously allowing motorists to pass without crossing the centerline. If wide outside lanes are deployed in an area with on street parking it is recommended that shared lane markings be used to encourage cyclists to stay out of the door zone.

WIDE OUTSIDE/WIDE CURB LANE SECTIONS

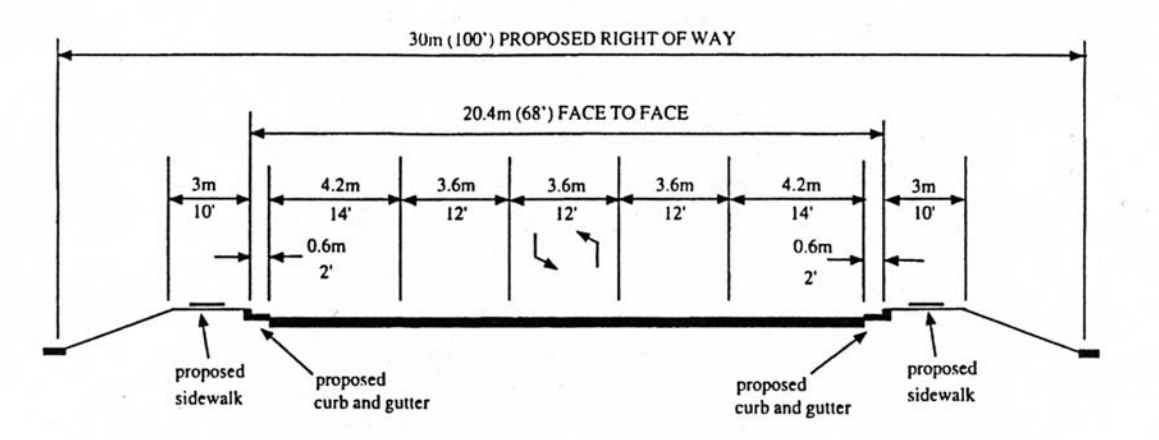
4-LANE MEDIAN DIVIDED TYPICAL SECTION

With Wide Outside Lanes



5-LANE TYPICAL SECTION

With Wide Outside Lanes



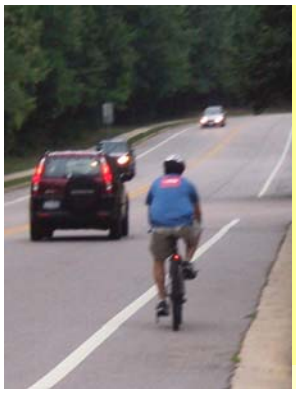
The above figures show typical roadway sections that include 14' wide outside lanes meant to facilitate the safe "same-lane" passing of bicyclists by automobiles. It is suggested that wide outside lanes be 16' or more on roadways with high speed limits, high volumes of traffic, or on street parking.

Source: NCDOT

BICYCLE LANES

DEFINITION

A bicycle lane is a portion of the roadway that has been designated by striping, signing, and pavement markings for the preferential and exclusive use of bicyclists.



This photo illustrates compatible conditions for striped bike lanes: two –lane residential/collector street; low posted speed limit; 4-foot wide bike lanes placed beside 12-foot wide travel lanes; and an absence of complicated intersections.

Location: Lake Pine Dr. @ Chimney Rise Dr.

WHEN TO CONSIDER THIS TYPE OF FACILITY

Bicycle lanes may be considered when it is desirable to delineate road space for preferential use by cyclists. Bicycle lanes are designed to separate bicyclists from overtaking motor vehicles in mid-block locations. Integrating bicycle lanes into intersection traffic patterns can sometimes be problematic. Strip development areas, or roadways with a high number of commercial driveways, tend to be less suitable for bicycle lanes due to frequent and unpredictable motorist turning movements across the path of straight-through cyclists.

Most bicyclists will choose a route that combines direct access with lower traffic volumes. Marking a roadway with bike lane striping creates fewer problems, especially for less-experienced bicyclists, in the following situations:

- Two-lane-streets with low traffic volume, low-posted speed limit, adequate roadway width for both bike lanes and 12’ wide travel lanes (32 ft minimum for two-lane road), no on street parking, and few driveways and intersections.

- A median-divided multi-lane roadway with lower traffic volumes and a low volume of right and left turning traffic would be a more appropriate location for bicycle lanes than a high traffic volume undivided multi-lane roadway with a continuous center turn lane.

PRINCIPAL PLANNING CONCERNS WITH BICYCLE LANES

- Although bicycle lanes may encourage cycling, there is conflicting research about whether or not they improve safety. Bike lanes can create safety challenges at intersections, where motor vehicle drivers may not be expecting cyclists to cross travel lanes in order to execute left turns. The Federal Highway Administration has found that bike lanes may discourage sidewalk cycling; however it has also been observed that bike lanes may encourage wrong way cycling.

- Bicycle lanes increase maintenance requirements. Debris accumulates in bicycle lanes because this area is not regularly swept by automobile traffic. Regular sweeping of bike lanes is necessary or some cyclists will avoid using them. Bicycle travel in debris-filled bicycle lanes is not safe or practicable and cyclists will be forced to remain in the travel lanes. The cost of regular sweeping regime should be taken into account during planning. Municipal staff must

ensure that there are adequate funds and equipment to maintain bike lanes. In contrast, wide outside lanes or "sharrows" need less cleaning because motor vehicles using that portion of the lane when no cyclists are present will blow debris to the far right side of the roadway.

- There should be no regulations restricting cyclists to bicycle lanes. Some cyclists prefer or need to use the main roadway to avoid debris or take destination-appropriate positions near intersections (e.g., for making a left turn or through travel).

- Bicycle lanes should not be striped in high traffic volume, strip-developed areas that would generate a high number of motor vehicle turning conflicts with straight-through cyclists.

- Most bicycle/motor vehicle crashes occur at intersections and driveways. Roadways with numerous driveways, complicated intersections and interchanges increase the potential for crashes. Bike lanes striped on roadways with numerous complicated intersections, including freeway interchanges, may give some less-experienced bicyclists a false sense of security.

- Substandard lane width or use of the concrete gutter pan as the bike lane area is not desirable.

- Abrupt termination of bike lanes at hazard or constraint locations creates a situation that may force bicyclists to make awkward movements in traffic.

- Bicycle lanes should not be striped adjacent to designated on-street parking due to the hazard of car doors opening into the bike lane space. Bicycle safety education teaches cyclists to stay completely out of the door zone, and bikeway engineering should not conflict with this.

- Bicycle lanes should not be striped where demand exists for undesignated on-street parking. Such situations invite conflict between residents and enforcement officers when the necessary parking prohibitions are enforced.

This photo illustrates an abrupt end of the bicycle facility. This is a hazard for the cyclist and motorist, because it forces the cyclist to merge abruptly into dense traffic.

Source: NCDOT

PLANNING AND DESIGN CONSIDERATIONS

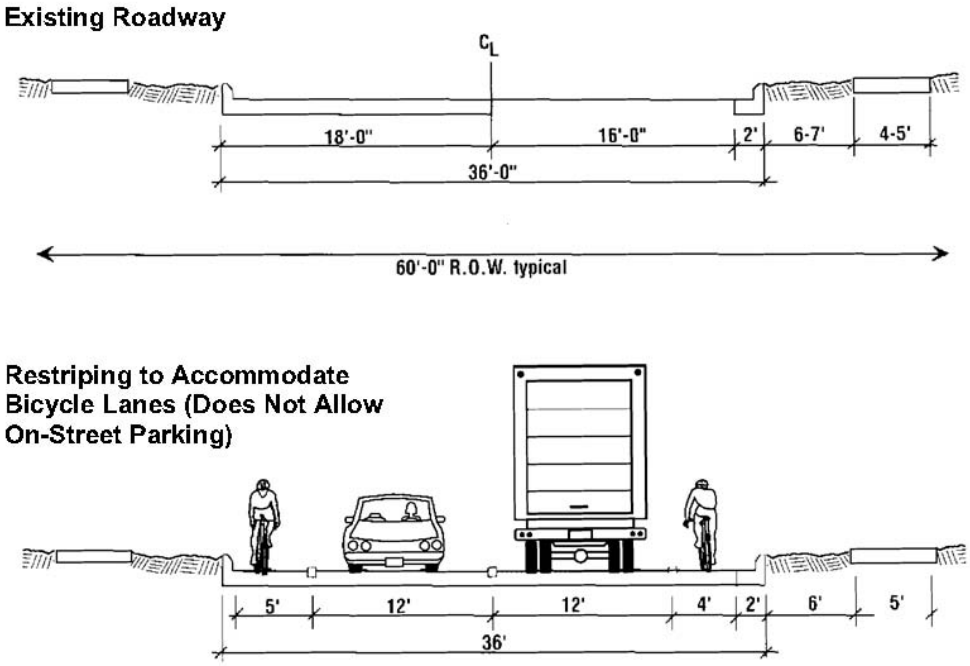
- Under ideal conditions, the minimum bicycle lane width is 1.2m (4 ft.), not including the concrete gutter pan. The minimum total width of bicycle lane and adjacent travel lane is 16 ft.

- Bicycle lanes should be one way facilities and should be marked to guide bicycle traffic in the same direction as adjacent motor vehicle traffic.

- Two-way bicycle lanes on one side of the road are not recommended because they promote riding against the flow of motor vehicle traffic. Wrong-way riding is a significant cause of car/bike crashes.

- On one-way streets, bicycle lanes should be on the right side of the road, unless it would reduce conflicts, such as at bus stops or right turn only lanes, if placed to left of a terminating lane or bus pull out.

- Bike lanes are not advisable on steep downgrades of 3 percent or more, where bicycle speeds greater than 25 mph are expected. As grades increase, downhill bicycle speeds will increase, which increases the problem of riding near the edge of the roadway. In such situations, bicycle speeds can approach those of motor vehicles, and experienced bicyclists will generally move into the traffic lanes to increase sight distance and maneuverability."



This illustration shows two alternatives for re-striping a road on a standard 60' right of way to accommodate bicycle lanes. The left side of the illustration shows a conversion from an 18' travel lane without a 2' gutter pan to a 12' travel lane with a 5' striped bike lane. The right side shows a conversion from a 16' travel lane with a 2' gutter pan to a 12' travel lane, a 4' striped bike lane and a 2' gutter pan.

Shared Lane Markings

DEFINITION

A shared lane marking (also known as "sharrow") is an experimental pavement marking intended to remind road users that cyclists are permitted and expected to operate in the same travel lane space as other drivers.

This photo illustrates compatible conditions for shared lane markings. On-street parking requires cyclists to operate close to the center of the adjacent travel lane to stay out of the door zone. The shared lane marking reminds cyclists and other drivers that this positioning is permitted and expected. *(City of San Francisco Photo)*

WHEN TO CONSIDER THIS TYPE OF FACILITY

Shared lane markings may be considered where it is desirable to remind road users that bicyclists operate in the same travel lane space and same direction as other drivers. In locations where narrow lanes or on-street parking make it unsafe for cyclists to ride far enough to the right to facilitate same-lane passing by automobile traffic, shared lane markings have been used to encourage cyclists to operate closer to the center of the lane. Shared lane markings are also intended to reduce sidewalk cycling, discourage wrong-way cycling, and promote courteous treatment of bicyclists by motorists.

Shared use arrows are sometimes used as a tool to promote awareness of bicyclists' right to the road without marking striped bicycle lanes that segregate users by vehicle type. A shared use arrow is typically placed in a narrow travel lane where automobile drivers must move into the adjacent lane to overtake, but may also be used in a wide lane where same-lane passing can be done safely.

PRINCIPAL PLANNING CONCERNS WITH SHARED USE ARROWS

- Bicyclists choose different lateral positions in the travel lane based on their destination, existing traffic conditions, and potential hazards they perceive. Shared use arrow installations may be designed to allow ambiguity in the expected lateral positioning of bicyclists within the lane. If a shared use arrow is instead designed to prescribe a particular lateral position for cyclists, that position will be incorrect for at least some cyclists some of the time.

- Shared use arrows should not be used to encourage cyclists to operate closer than normal to the edge of the road or to hazards such as parked cars for the purpose of promoting easier overtaking by automobile traffic. If the lane width does not facilitate safe and easy same-lane overtaking of cyclists operating normally, then use of markings to promote side-by-side same-lane operation may elevate risk for cyclists.

- Given that bicyclist collisions with opening car doors often outnumber overtaking-type collisions in urban areas, some communities have strategically positioned shared use arrows well outside of the door zone of parked cars to encourage cyclists to ride safely outside of the door zone. Often this results in the shared use marking being located near the center of the lane, such that automobile drivers must move into the adjacent lane space to overtake bicyclists. The city of San

Francisco, California reports that such installations have effectively increased the average distance between cyclists and parked cars, while at the same time increasing the distances at which overtaking motor traffic passes bicyclists. *(Source: San Francisco's Shared Lane Pavement Markings: Improving Bicycle Safety, Final Report, San Francisco Department of Parking and Traffic, February 1994)*

- At the time of this writing, shared use arrows have not been approved by the National Committee on Uniform Traffic Control Devices (NCUTCD), and are considered experimental devices.

This graphic illustrates the "Chevron" style of shared lane marking recommended in San Francisco's 2004 shared lane marking report.

North Carolina State University has placed sharrows on campus to keep bicyclists out of the door-zone.

PLANNING AND DESIGN CONSIDERATIONS

- **The Shared Lane Marking has not been approved for inclusion in the Manual on Uniform Traffic Control Devices (MUTCD).** In February 2005 the NCUTCD Bicycle Technical Committee recommended the following draft language for shared use arrows for potential inclusion in future revisions of the Manual on Uniform Traffic Control Devices (MUTCD):

Shared Lane Marking

Support:
The Shared Lane Marking is intended to:

1. Help bicyclists position themselves in lanes where the traveled way is too narrow for a motorist and a bicyclist to travel side by side within the same traffic lane.
2. Encourage safe passing of bicyclists by motorists.
3. Reduce the chance of a bicyclist's impacting the open door of a parked vehicle in a shared lane with on-street parallel parking.
4. Alert road users of the lateral location bicyclists may occupy.
5. Reduce the incidence of wrong-way bicycling.

Option:
The Shared Lane Marking shown in Figure 9C-XX may be used to assist bicyclists with positioning in a shared lane and to alert road users to the location a bicyclist may occupy.

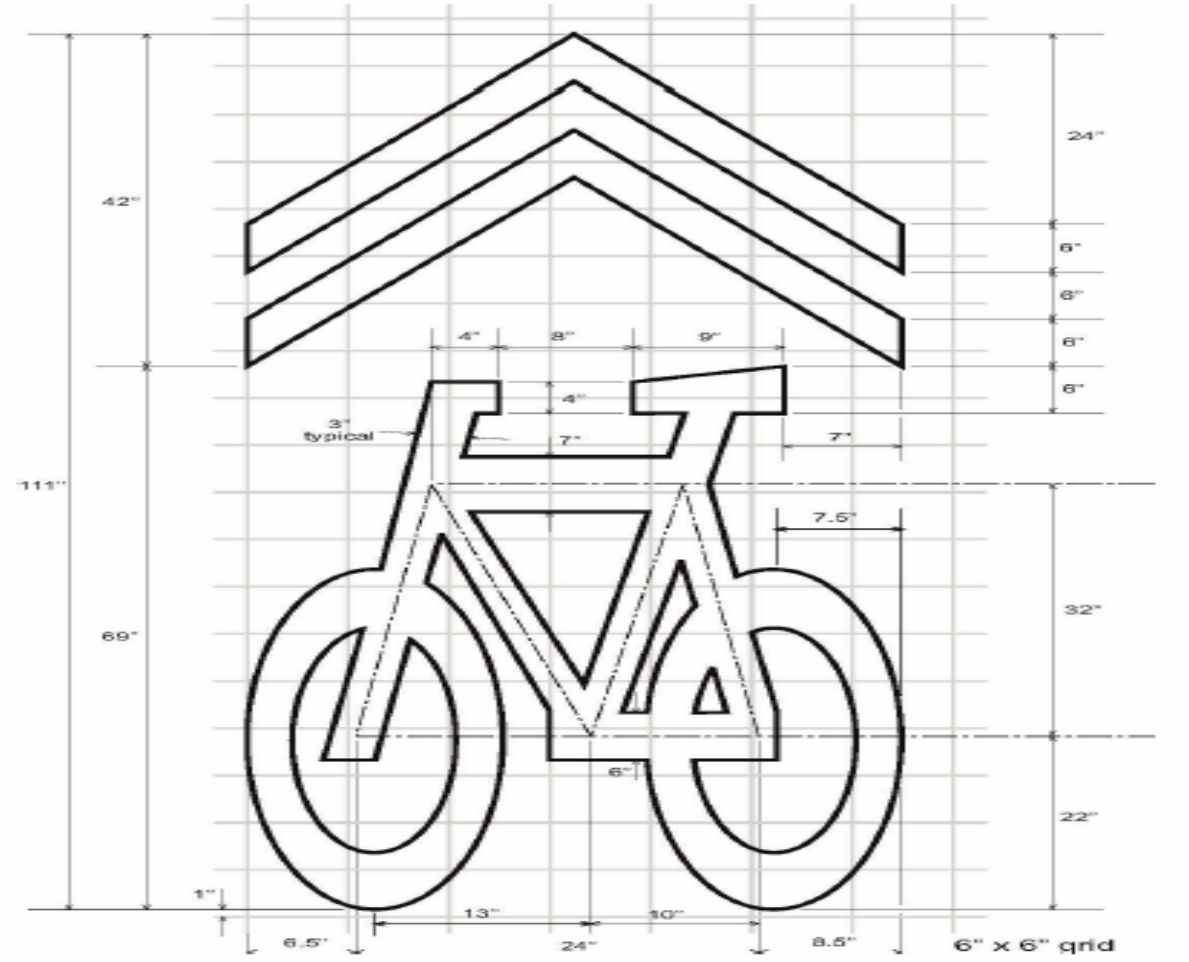
Standard:
If used in a shared lane with on-street parallel parking, Shared Lane Markings shall be placed so that the centers of the markings are a minimum of 3.4 m (11 ft) from the curb face, or from the edge of pavement where there is no curb.

Guidance:

If used, the Shared Lane Marking should be placed immediately after an intersection and spaced at intervals not greater than 75 m (250 ft) thereafter. If used on a street without on-street parking with an outside travel lane less than 4.2 m (14 ft) wide, the centers of the Shared Lane Markings should be no closer than 1.2 m (4 ft) from the curb face, or from the edge of pavement where there is no curb. The Shared Lane Marking is recommended primarily for use in urban areas.

Option:
Where used on a shared lane with on-street parking, the distance from the curb, or from the edge of pavement where there is no curb, may be increased beyond 3.4 m (11 ft).

Figure 9C-XX. Shared Lane Marking



WIDE PAVED SHOULDERS

Wide paved shoulders may be added to sections of existing roadways where there is a desire to allow motor vehicles to pass without entering the adjacent lane, such as on curves, hillcrests, and busy roads. In rural areas wide paved shoulders can dual as a pedestrian facility where there is not a need for a separate sidewalk facility.

Source: NCDOT

DEFINITION

A paved shoulder refers to the part of the highway that is adjacent to the regularly traveled portion of the highway and is on the same level as the highway. Ideally, wide paved shoulders should be included in the construction of new highways and the upgrade of existing highways where there is a significant level of current or potential bicycle travel. A wide paved shoulder refers to additional pavement width of at least 4' that has been added to an existing roadway for the convenience of motor vehicle operators. A well-maintained wide paved shoulder allows cyclists to travel outside the main roadway so that motor vehicles can pass without entering the adjacent lane. Wide paved shoulders not only benefit motorists, but reduce road maintenance costs and may improve safety for bicyclists.

WHEN TO CONSIDER THIS TYPE OF FACILITY

On urban streets with curb and gutter, wide outside lanes and bicycle lanes are usually the preferred facilities. Shoulders for bicycle use are not typically provided on roadways with curb and gutter.

- On rural roadways where bicycle travel is common, such as roads in coastal resort areas, wide paved shoulders are highly desirable.

- On secondary roadways without curb and gutter where there are few commercial driveways and intersections with other roadways.

PRINCIPAL PLANNING CONCERNS WITH WIDE PAVED SHOULDERS

This type of facility is most frequently used in rural areas on both primary and secondary roads. Sufficient right-of-way is needed to accommodate paved shoulders and, if necessary, to relocate drainage ditches that run parallel to the roadway.

- Shoulders that are paved to accommodate bicycle traffic are generally full-depth or equal to the

pavement depth of the adjacent roadway. Partial-depth paved shoulders are rarely recommended because of the tendency to crack under vehicular loads.

- Rumble strips and other devices used to alert sleepy motorists should be avoided, because they pose a safety hazard to bicyclists. If rumble strips are necessary, additional shoulder width should be provided for the bicyclists.

- Wide paved shoulders must be swept clean regularly to remove debris that will otherwise accumulate in them. Bicycle travel in debris-filled shoulders is not safe or practicable and cyclists will be forced to remain in the roadway. (Wide outside lanes need less cleaning because motor vehicles using that portion of the lane when no cyclists are present will blow debris to the far right side of the roadway.)

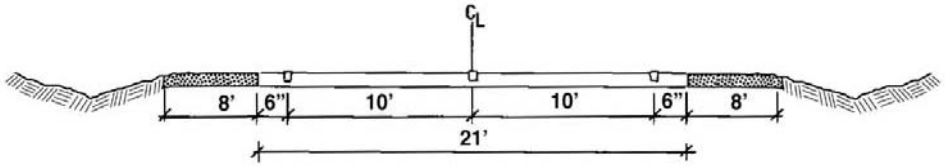
- There should be no regulations restricting cyclists to the shoulder. Even in the presence of wide paved shoulders, cyclists will sometimes prefer or need to use the main roadway to avoid debris and take destination-appropriate positions near intersections (e.g. for making a left turn or through travel).

PLANNING AND DESIGN CONSIDERATIONS

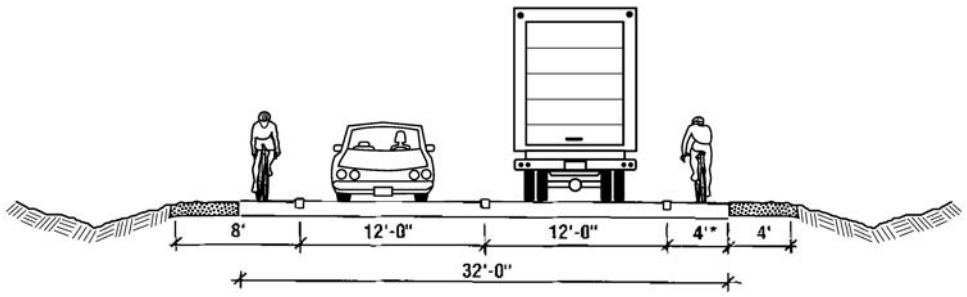
The paved shoulder should be of adequate width, smoothly paved, and have adequate strength and stability to support vehicle loads without rutting. The minimum width for a paved shoulder to accommodate bicycles is 1.2m (4 ft). The minimum combined width of paved shoulder and adjacent travel lane should be 16 feet. Recommendations for the actual paved shoulder width may vary according to the width of the adjacent roadway, traffic volume, posted speed limit, and the presence of heavy truck traffic along the roadway. The slope of the roadway should continue across the shoulder to maintain adequate drainage. At right-turn-only lanes, the outside through lanes should be widened to better accommodate through cyclists, who must by law operate to the left of the right-turn-only lane. If right-turn-only lanes are frequent, continuous wide outside through lanes may be preferable as a bicycle accommodation.

WIDE PAVED SHOULDER SECTIONS

Existing Roadway



Roadway Retrofitted with 4-Ft Paved Shoulders



* If speeds are higher than 40 mph, shoulder widths greater than 4' are recommended.

MULTI-USE PATHWAYS

Multi-use paths are physically separated from roadways. It is generally not advisable to locate a two-way bicycle path immediately adjacent to a roadway because of confusion at driveways and intersections.

Source: NCDOT

DEFINITION

A multi-use pathway is physically separated from motor vehicle traffic, and can be either within the highway right-of-way or within an independent right-of-way. Multi-use pathways include bicycle paths, rail-trails or other facilities built for bicycle and pedestrian traffic.

WHEN TO CONSIDER THIS TYPE OF FACILITY

When properly located, multi-use pathways can be attractive facilities for novice and child bicyclists because they do not have to share the path with motor vehicles. To function correctly, multi-use pathways must be designed according to well-established design standards. These design standards include adequate width for two-directional use by both cyclists and pedestrians, provision of good sight distance, avoidance of steep grades and tight curves that force bicyclists to make awkward movements, and minimal cross-flow by motor vehicles. Multi-use pathways can serve a variety of purposes, including recreation and transportation. For transportation purposes, a multi-use pathway should have a well-defined origin and destination. Multi-use pathways should not be located immediately adjacent to a roadway because of safety considerations at intersections with driveways and roads. The bicyclist and motorist each believe that he or she has the right of way; the result can be a bicycle/motor vehicle collision. Studies have shown that such parallel multi-use pathways are approximately twice as dangerous for bicyclists as riding in traffic with motor vehicles.

- A multi-use pathway should have a well-defined origin and destination such as schools, residential subdivisions, and shopping centers.
- A multi-use pathway can be an attractive facility for novice and child cyclists, if properly located and designed.
- Sidewalks should never be designated as multi-use pathways.

Two-way multi-use pathways located adjacent to roadways may result in bicycle/motor vehicle conflicts at driveways and intersections

PRINCIPAL PLANNING CONCERNS WITH MULTI-USE PATHWAYS

- Multi-use pathways should not be considered as a substitute to on-roadway accommodation of cyclists. Many experienced cyclists will prefer to use roadways over multi-use pathways for safety and efficiency reasons. Never sign a pathway adjacent to a roadway as a bikeway, because those cyclists who use the often safer roadway section may experience harassment from motorists who assume that cyclists are not permitted on the roadway.

- An alignment with the fewest intersections with roadways should be chosen.

- Multi-use pathways are generally expensive to build because they are entirely separate facilities from the roadway. Well-defined origins and destinations help justify the expense involved in implementing a multi-use pathway project. Multi-use pathways intended for transportation should be as direct as possible or many bicyclists will choose a shorter route, such as a nearby roadway.

- Multi-use pathways located adjacent to roadways may result in bicycle/motor vehicle conflicts at driveways and with turning traffic at intersections.

- Where significant pedestrian usage is anticipated, additional width should be provided.

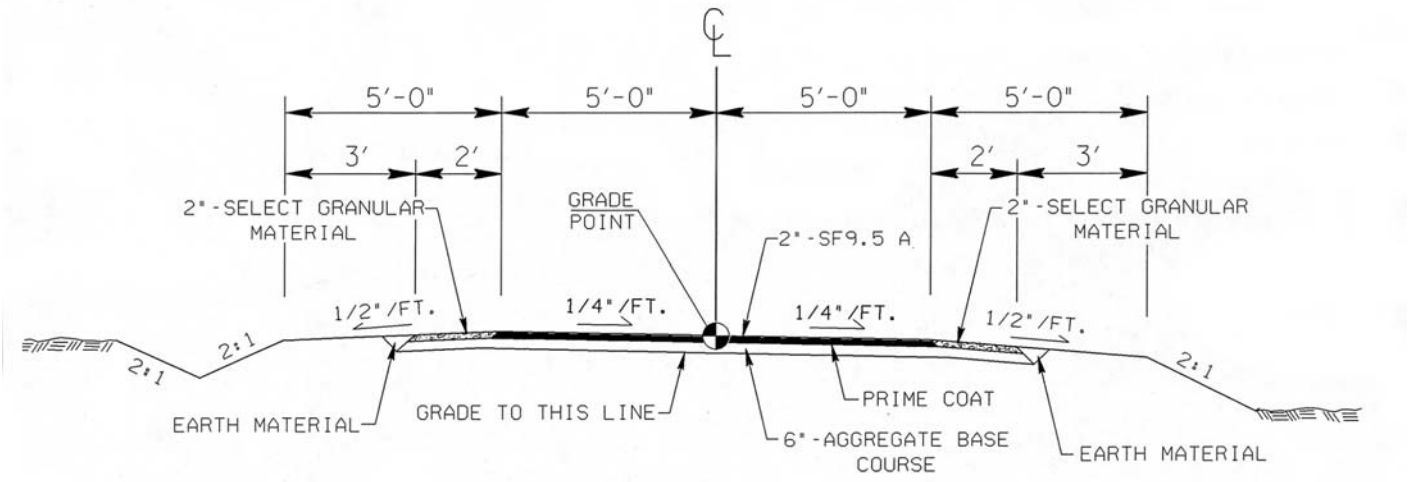
- No regulations should restrict cyclists to multi-use path where one exists. Some cyclists prefer to use the roadway because, for example, it is more convenient for their destination or they are traveling at speeds that would be unsafe with the mix of pedestrians, children, and novice cyclists on the path.

PLANNING AND DESIGN CONSIDERATIONS

Addressing planning and design concerns for a multi-use pathway is very much like selecting a roadway functional design. Some similar design considerations include horizontal and vertical alignment, sight distance, grades and pavement structure. Also where a path intersects with a roadway or other vehicular facility, care must be taken to carefully design the junction much like a road-road intersection, with movement to and from the path along all potential desire lines accommodated by appropriate traffic control devices, sight lines, surface transitions, etc. The minimum paved width for a two-directional multi-use pathway is 3 m (10 ft); however, a path wider than 3 m is very desirable when usage by both bicyclists and pedestrians is expected to be high. When a multi-use pathway must be located parallel to a highway due to a lack of an alternative location, a minimum separation of 1.5 m (5 ft.) should be provided between the roadway and multi-use pathways. If 1.5 m of separation cannot be obtained due to limited right-of-way, a suitable positive barrier between the roadway and multi-use pathway should be provided.

RECOMMENDED TYPICAL SECTION OF 10-FT ASPHALT PATHWAY

With 2-Ft Select Material Shoulder



Two way multi-use pathways less than 10' in width are not recommended due to probable conflicts between pedestrians and cyclists. If heavy bicycle traffic is anticipated multi-use pathways should be wider than 10'.

Source: NCDOT

GRADE-SEPARATED CROSSINGS

An underpass continues this shared use path beneath a 4-lane highway with high traffic volumes

Source: NCDOT

DEFINITION

A grade-separated crossing provides continuity of a bicycle/pedestrian facility over or under a barrier. A bicycle/pedestrian crossing structure may be either a bridge or an underpass.

WHEN TO CONSIDER THIS TYPE OF FACILITY

A grade-separated crossing should be considered when a bicycle facility meets a barrier, such as an active multi-track railroad, stream, high volume arterial, or freeway, and continuity of the route is desired. There are two main types of grade-separated crossings: overpasses (bridges) and underpasses (most often these would be culverts). When a heavily utilized multi-use pathway intersects with a high volume multi-lane roadway, it is desirable to provide an overpass or an underpass to separate multi-use pathway users from conflicts with motor vehicle traffic.

Grade separated pedestrian and bicycle crossings should be incorporated, where appropriate, as a part of road widenings and developments that create safety hazards for an existing greenway or multi-use path. Incidental projects (grade separations included in projects) cost much less than independent projects and mitigate safety concerns as they arise instead of delaying them indefinitely.

In the Neuse River Basin and elsewhere, in most cases, greenways are an acceptable use within riparian buffers. If a planned or existing greenway intersects a roadway near a stream or river crossing it is advantageous to plan and construct for a bridge wide enough to accommodate the greenway beneath the bridge. This is especially true if the road is a high volume facility that would not be easily traversed by bicyclists or pedestrians.

Substantial width should be requested by planners when a bridge replacement or new location roadway is in the early stages of design. Including appropriate width during the construction of a roadway bridge can save money in the long run by eliminating the need for an independent project in the future.

If planned and constructed properly, bridges over streams and rivers can be made wide enough to accommodate a multi-use path beneath them.

Location: US 70 at Crabtree Creek

PRINCIPAL PLANNING CONCERNS WITH GRADE-SEPARATED CROSSINGS

- Bicycle/pedestrian grade separations that are to be included as part of state highway construction projects should already be identified in locally adopted bicycle or greenway master plans by the time a proposed highway improvement is in the early stages of design.

- Independently this type of facility can be expensive and difficult to implement. For these reasons, advance planning, identification of source funds, and a compelling purpose and need are primary factors in implementing bicycle/pedestrian bridges or underpasses.

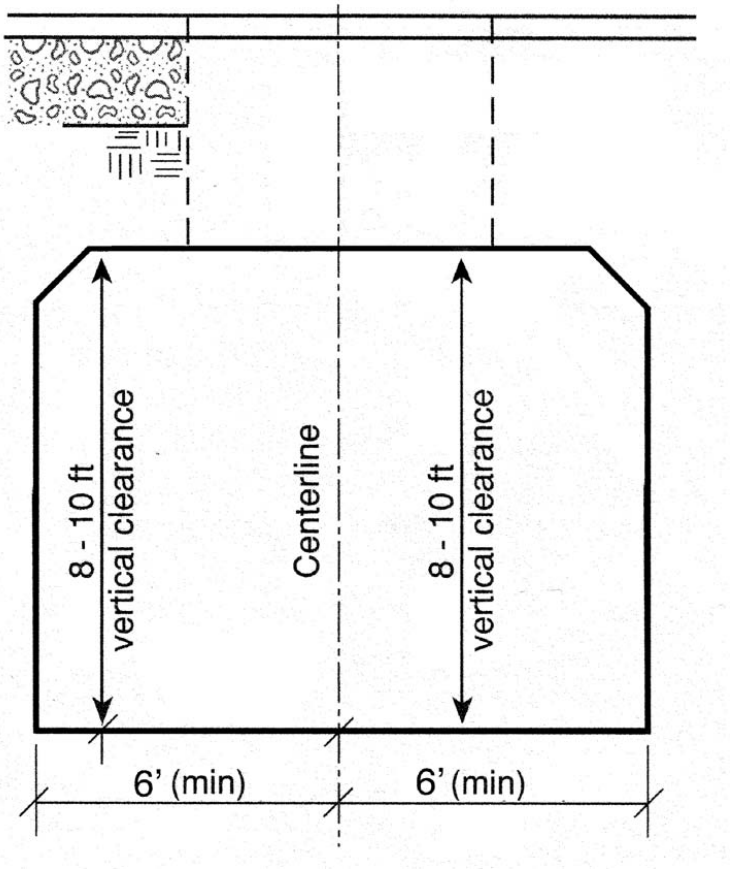
- Many bicyclists and pedestrians will not use an overpass that is inconvenient. Instead, pedestrians may choose a time saving, and sometimes more hazardous crossing. In some cases planners and officials should focus on improving the safety of pedestrians and cyclists at locations where a grade-separated route would be inconvenient. If reasonably safe at-grade crossing is impossible to facilitate, fencing or other controls may be required to reinforce use of the grade-separated facility.

SAFETY CONSIDERATIONS

There are many safety considerations when proposing this type of facility, such as lighting, maintenance, and bicycle/pedestrian friendly design features. Underpasses should be adequately lighted, if night use is permitted, in order to improve safety. If a greenway is placed adjacent to a stream there may be a need to remove storm debris from the path after significant rainfall.

It is important to design a facility of adequate width and height to accommodate both pedestrian and, faster moving bicycle traffic. A minimum asphalt wide of twelve feet is suggested for these types of crossings. Additional width should be provided depending on anticipated levels of bicycle and pedestrian traffic. Vertical distance should be minimized in order to encourage use and maximize efficiency.

TYPICAL CULVERT CROSSING FOR MULTI-USE PATH



SIGNED BICYCLE ROUTES

Signed bicycle routes are best implemented on existing low traffic volume residential or secondary roadways where the need for additional construction is not necessary.

Source: NCDOT

DEFINITION

A signed bicycle route is typically designated along more lightly traveled residential or secondary roads and is indicated by signs with or without a specific route number. This type of facility should have appropriate directional and informational markers. Signed bicycle routes are designated by the jurisdiction having authority over the roadways included in the bicycle route system. Adding pavement width to the existing roads signed as bicycle routes is not normally required; however, choosing routes with minimal traffic hazards is typically part of the process to create a good route. Bicycle routes are often utilized to direct bicyclists to less-congested roadways that may follow the same general corridor as more heavily traveled arterial highways.

WHEN TO CONSIDER THIS TYPE OF FACILITY

A bicycle route is a suggested route based on its pleasant characteristics for cycling. It may include stretches of other designated bicycle facilities, but in general, a bicycle route does not require that the road include any special bicycle facilities. For instance, a signed bicycle route may designate a preferred set of roads from a school to a residential neighborhood. A network of such routes may be connected to provide bicyclists with an appealing way to get around the community. The goal of signage on bicycle routes is to provide effective way-finding for cyclists using the routes. Bike route signs should include route-specific labels, especially where two or more routes intersect, to assist in navigation. Planning for a bicycle route begins by defining the purpose and need for the facility.

- Designating a bicycle route is a cost-effective way to inform bicyclists of a way to get to their destinations.
- A bicycle route should have a well-defined signed route
- A bicycle route should be part of a comprehensive bicycle system

PRINCIPAL PLANNING CONCERNS WITH BICYCLE ROUTES

- For recreational oriented routes in rural areas scenic routes with low traffic volumes are preferred by bicyclists.
- For transportation oriented routes, direct routes are preferred.
- Bicycle route signs should include directional arrows to guide the bicyclist at intersections with other roadways.
- The route should be field checked to avoid potential design and traffic hazards.
- A map showing the bicycle routes in an area is a good way to inform bicyclists about the bicycle route network. Mapping encourages greater use of these routes.
- The signage of roads as bicycle routes does not substitute for accommodation of bicyclists on other roads. Since bicycle routes are often routed on lesser-traveled roads for the pleasure of recreational cyclists, utility cyclists such as bicycle commuters will still desire to use busy, important streets that recreational cyclists may prefer to avoid.

PLANNING AND DESIGN CONSIDERATIONS

Some key elements of bicycle route selection include roadways with adequate width, high quality pavement, less dangerous intersections, curves with good sight distance and hills without steep grades. Such traffic conditions as motor vehicle volume, posted speed limits, and high percentages of truck traffic should also be considered. Another important consideration should be that the system of signed routes connects origins and destinations that are of interest to bicyclists.

Mapped and signed bicycle route systems provide information on safer places to bicycle.

Source: NCDOT