L E S S O N 2 3

# European Approaches to Bicycle and Pedestrian Facility Design

## 23.1 Purpose

Much has been written in recent years regarding many of the successful non-motorized programs in western Europe, including The Netherlands, Germany, England, and Switzerland. This lesson includes excerpts from a 1994 Federal Highway Administration report entitled *FHWA Study Tour for Pedestrian and Bicyclist Safety in England, Germany, and The Netherlands*, specifically those sections that describe innovative European approaches to bicycle and pedestrian facility design.

## 23.2 Pedestrian Facilities

**1. Zebra crossings** (England, see figure 23-1 below) include zebra crosswalk stripes across the road with dashed lines used to mark the crosswalk on both sides. "Belisha Beacons" (poles with fashing orange lights - see photo below) are placed on each side of the crosswalk. These crossings are installed at selected mid-block locations (never at intersections). At zebra crossings, pedestrians have the right of way, and drivers must yield (i.e., slow or stop) to pedestrians in the crosswalk. Zebra crossings are preceded by zigzag pavement markings next to the curb on the vehicle approach.

**2. Pelican crossings** (England) are mid-block crossings controlled by traffic signals and push-button pedestrian signals. The push-button hardware lights up and conveys specific messages to pedestrians during each interval, as shown in Figure 23-2. A walking green man symbol and a standing red man are displayed, as shown in Figure 23-3. A flashing green man indicates pedestrian clearance. A flashing green man on the pedestrian approach concurrent with flashing amber and red balls on the vehicle approach precedes the green ball indication on the vehicle approach. Instead of zebra crosswalks, pelican crossings have dashed (not solid) parallel lines to mark the crosswalk. As with zebra crossings, pelican crossings are not used at intersections, but are installed only at selected mid-block locations.

**3. Toucan crossings** (England, see figure 23-4) are shared crossings for pedestrians and bicyclists (cyclists "too can" cross together) at selected

***Figure 23-1. Zebra crossing with belisha beacons in London.***

crossings at the intersection of roadways with pedestrian and bicycle paths. The preferred layout includes a tactile warning surface, audible beepers or tactile rotating knobs, push-buttons with WAIT displayed in each corner of the crossing, infrared lamp monitoring, and vehicle detection on all approaches. The desirable crosswalk width is 4 meters; the minimum acceptable width is 3 m. Signal indications include standing red man, walking green man, and green bicycle. The flashing amber with the red ball indication is not used for the vehicle approach. Crosswalk lines are delineated by white squares.


*Figure 23-2. Pedestrian push-button hardware in Great Britain gives feedback regarding when to cross.*

*Figure 23-3. Pedestrian green man (WALK) and red man (DON'T WALK) signal displays.*

**4. Puffin (Pedestrian User-Friendly INtersection) crossings** (England), generally installed at intersections, consist of traffic and pedestrian signals with red push-button devices and infrared or pressure mat detectors. After a pedestrian pushes the button (or stands on the mat), a detector verifies the presence of the pedestrian. This helps eliminate false signal calls associated with children playing with the signal button or people who push the button and then decide not to cross. If a pedestrian is present at the end of a vehicle cycle, the red traffic signal is indicated to motorists, and pedestrians see the green man (i.e., WALK display). A separate motion detector extends the green interval (if needed) to ensure that slower pedestrians have time to cross safely. If a pedestrian pushes the button, but fails to wait for the green man symbol, the detector will sense that no pedestrian is waiting and will not stop motor vehicle traffic needlessly.

Puffin crossings are recent developments and are said to improve pedestrian safety and reduce unnecessary vehicle delay. Since the motion detector can detect only those pedestrians walking within the crosswalk lines, physical barriers are used on the curbs to channel pedestrians into the crosswalks. At some crossings, tactile surfaces have been introduced that guide a visually impaired person to the crosswalk. Puffin crossings are currently used at 27 demonstration sites in England. One official stated that they expect to eventually replace all pelican and toucan crossings with puffin crossings if they are found to be effective based on the number of pedestrian accidents, vehicle delays, detector and equipment adequacy, and other factors.

*Figure 23-4. Toucan crossings in Great Britain provide separate pedestrian and bicyclist signals where trails cross roadways.*

**5. Pedestrian messages** (England), such as LOOK RIGHT or LOOK LEFT (see figure 23-5), are painted

on the street next to the curb to remind pedestrians which direction to look for motor vehicle traffic prior to stepping into the street. These messages are used extensively in London, where many tourists visit. (Many U.S. tourists are accustomed to looking left for traffic before stepping off the curb and looking right for traffic when standing at a pedestrian island in the middle of a two-way street.)

*FIGURE 23-5. Pedestrian pavement messages and refuge islands.*

**6. Traffic signals** (The Netherlands). Pedestrian signal displays include a standing red man (i.e., DON'T WALK) and a walking green man (i.e., WALK). A flashing green man (i.e., you may walk, but the red man display will follow soon) follows the steady green man phase. Pedestrian push buttons are also used at some crossing locations (see figure 23-6). Pedestrian signals are placed at arterial intersections with high volumes of pedestrians and motor vehicles. They are installed near the vehicle traffic signal.

A flashing yellow indicator has been tested in The Netherlands (along with legal regulations) in some simple situations instead of a solid red ball for pedestrian signals. The symbol used for the yellow indicator is a triangle with an exclamation point inside it. The flashing yellow tells pedestrians that they may cross at their own risk, but other traffic has priority. The zebra crosswalk markings are removed at such locations to avoid suggesting that pedestrians have priority in crossing. The pedestrian green is an exclusive movement and, therefore, should be conflict-free. The motivations for testing this symbol include the following:

- Whether the pedestrian signal phase is actuated or pre-timed, pedestrians are allowed to choose between crossing with the green indication or crossing during the flashing yellow indication during an appropriate gap in traffic.
- Since the red indication is replaced by a flashing yellow, the situation allows for 100-percent compliance by pedestrians. Pedestrians no longer cross against the red indication because there is no longer a red indication.
- At actuated locations, less time is consumed by exclusive pedestrian movements. Since pedestrians know that it is legal to cross whenever they want, they may not bother to call for the pedestrian green.
- The Dutch also state that the use of flashing yellow indicators enhances the status of the red indication. Red indications will only be used at complex crossing locations.

*FIGURE 23-6. Pedestrian barriers (separators) are used extensively in London to channel pedestrians to preferred crossing locations.*

The disadvantages found with the triangle signal include the following:

- It is unknown whether pedestrians understand that they do not have the right of way while they are crossing during the flashing yellow indication. However, it appears that turning traffic must give way to pedestrians; therefore, an exclusive turn arrow cannot be combined with a flashing yellow pedestrian indication.


*Figure 23-7. Pedestrian mall in Munster, Germany.*

- It is safer for pedestrians to cross with the green indication in conflict-free situations. The situation of crossing during a flashing yellow pedestrian indication is still the same as crossing during a red indication. It is difficult to explain it to children and to convince them that they should wait for the green while they see others crossing at times when the light is yellow or red. Many elderly persons feel safer crossing in groups rather than alone. Following the crowd, an older person may end up at the tail end of the group, exposed to oncoming vehicles and unable to sprint to safety.

Another device tested in The Netherlands was a "pedestrian sender." This device provides a means for signal preemption for vulnerable pedestrians, including the visually and mobility impaired The pedestrian sender is similar to the emergency beepers used by the elderly and impaired to call for help. This device influences the traffic controller by doubling the pedestrian green time, activating an acoustic signal, and preventing conflicting traffic movements. No information about providing a directional indication to the vulnerable pedestrian was available. The results of a questionnaire indicated great enthusiasm for the pedestrian sender. The survey also indicated no misuse of the device.

While pedestrian improvements in Delft were said to lag behind bicycle facilities, pedestrian signals were installed at selected intersections in that city. A green man, yellow triangle, and red man were used for the WALK, DON'T START (clearance), and DON'T WALK intervals, respectively. Zebra-striped crosswalks are commonly used at pedestrian crossings.

**7. Pedestrian zones** (Germany), which can also be used by cyclists during off-peak hours (i.e., evenings), have been established on many downtown streets. Not only are there fewer conflicts with pedestrians during off-peak hours, but it was claimed that the presence of pedestrian and bicycle traffic helped eliminate crime and added an element of personal safety. The pedestrian mall shown in figure 23-7 allows bus, bike, and taxi travel throughout the day. In Freiburg, on Kaiser Josef, a pedestrian street, cars and bicycles are not permitted. Streetcars and pedestrians have exclusive use of the street.

***FIGURE 23-8. Some bicycle paths parallel roadways, such as this one in Groningen, The Netherlands.***

## 23.3 Bicycle Facilities

**1. The Netherlands.**
The general philosophy in The Netherlands is to separate bicyclists from motor vehicles whenever speeds increase to greater than 30 km/h. According to one official, bicycle paths are safer than bike lanes between intersections. At intersections, however, a separate bicycle path will generally have a higher number of accidents. Separate bicycle paths (see figure 23-8) are considered desirable under heavy motor vehicle traffic

conditions, but undesirable along streets with low volumes of motor vehicles. Their general approach to bicycle facilities is to avoid making them too sophisticated.

Bike lanes are typically wide enough for two cyclists to ride side-by-side. The bike lanes are generally reddish in color, with visible (and well-maintained) white bicycle symbol markings (see figure 23-9). Bike lanes are typically located between the motor vehicle lane and the sidewalk and are sometimes part of the sidewalk. Sometimes, problems occur with motor vehicles parked on the bicycle lane. Bike lanes are sometimes marked through intersections, as shown in figure 23-10.

*Figure 23-9. Typical bicycle lanes in The Netherlands are often reddish in color and wide enough for two cyclists to ride side-by-side.*

**Bicycle Signals**

In The Netherlands, separate bicycle signals are commonly used at arterial intersections that have bike lanes and high volumes of bicyclists and motor vehicle traffic. The bicyclist signals are vertical red, amber, and green bicycle symbols mounted on a pole, as shown in figure 23-11. They are located either next to the vehicle signal head (i.e., using the same 20-centimeter diameter signal face as the vehicle signal) or at a lower level (1 meter high) using a smaller size signal face (7 to 7.5 centimeter).

The signal indications are all steady (i.e., no flashing indications), and there is typically an advance green phase for bicyclists, with a simultaneous red phase for right-turning motor vehicles. According to one local official, levels of compliance with the signal are generally not very high.

In some cities, such as The Hague and Groningen, a special bicycle phase allows bicyclists in the bike lane to proceed straight before motor vehicles (i.e., right-turning traffic) are allowed to proceed. Motor vehicles are not allowed to turn right on red in The Netherlands, although bicyclists are allowed to do so in certain cities and locations. Bicycle lanes are not typically placed to the right of parked cars, since motorists cannot see bicyclists as easily. It is common for bicycle lanes to end before intersections. Mixing traffic before an intersection promotes anticipation and interaction among road users at the crossing. Otherwise, automobile drivers turning right often are not fully aware of bicyclists and moped riders coming from an adjacent bicycle lane.

**Bicycle Rental**

Renting a one- or three-speed bicycle in The Netherlands is relatively inexpensive, costing approximately 10 guilders (about US$6) per day or about 50 guilders (US$30) per week. Bicycle rental shops are located throughout towns and cities, commonly at train stations. Information on bicycle rentals is provided at local hotels.

**2. Germany**

On-street bike lanes are installed on the street level and are typically painted red or installed with a red pavement surface. This type of facility is generally

*Figure 23-10. Bike lanes are sometimes marked through intersections.*

less expensive to install than off-street facilities.
Off-street bike lanes are sometimes installed on the sidewalk level, as shown in figure 23-12. Generally marked with a distinctive red color (which contrasts with the gray stone used for pedestrian walkways and the clear zones between the street and bike path), these lanes provide a greater separation between bicyclist and motor vehicles. When a parking lane exists, this separation allows room to open car doors without obstructing the bike path.

*Figure 23-11. Bicycle signal used in Amsterdam.*

As observed in Munster, bike paths are typically 1.6 meter wide (one direction on each side of the street), and the separation between cars and the bike path is generally 0.7 meters wide. Some areas are narrower in cases where sufficient room does not exist. This type of facility was originally promoted in the 1940's as a means to eliminate the "hindrance" to cars that was caused by bikes. They are now retained to separate cars and bicyclists for safety purposes.

Bike tracks are generally paths through the countryside and are signed routes. They are generally not paved.

*Figure 23-12. Off-street bicycle/pedestrian path in Germany.*

Bus lanes that can also be used by bikes require a width of 4.5 meters or more to allow buses to easily and safely overtake cyclists when necessary. As shown in figure 23-13, these facilities are signed and marked with a bus and bike symbol.

Intersection improvements that facilitate bike travel include an advance stop line that allows bicyclists to exit sidewalk paths to turn left in front of motorized traffic. This allows a safer path for left-turning cyclists, provides better visual contact between bikes and cars, and allows cyclists to be away from vehicle exhaust. This design has been found to be safer than the traditional weave condition. Other signal treatments include special advance green signals for cyclists, and, in some cases, signals timed for bicycle traffic (based on a signal progression of approximately 9 mph). It was also observed during site visits that traffic signal heads in Munster had one green cycle signal head and two red cycle signal heads. This was done to improve the visibility of the red cycle signal.

Bike parking lockers and sheltered spaces are offered at some park-and-ride or park-and-bike lots at transit stations (see figure 23-14). Each bike locker can hold two bikes and provides better security for more expensive bicycles than at bicycle shelters. The rental fee for bike lockers is 20 deutsche marks US$11.70) per month, which is much less expensive than car parking. This particular lot has 108 car parking spaces, and is on the outskirts of the built-up area of the city. The construction cost is much less for bike parking facilities than for car parking. Furthermore, about 10 to 12 bikes can be parked in a single car parking space.

Bike parking at the train station facilitates train-bike combination trips. Bikes are parked in monitored

areas and can be parked for 4 days before being moved to a long-term parking area. This allows train commuters to leave their bikes at the train station over the weekend. The City of Munster is also planning a 4,000-space underground bicycle parking facility at the train station.

Separate signal heads for bicyclists, as well as separate distinctive signal heads for trolleys, are used where exclusive bus lanes exist (using vertical or horizontal white lines as bus signal displays). This often results in three sets of signal heads side-by-side (car, trolley, and bike).

*Figure 23-13. Lane used for buses and bicyclists only.*

Installing bike racks at corners also helps intersection visibility. The study team was shown an intersection where car parking at the intersection had previously created a visibility problem for motorists on the side street. The problem occurred even after NO PARKING signs were posted. Installing bike racks at the corner physically prevented car parking and opened up sight distances for side-street traffic.

Bicycle lanes with continuous lane markings are reserved solely for bicyclists. If the lane is dashed, cars and trucks may use the space only when no bicycle is present.

**3. Great Britain.**

A variety of bicycle fatalities occur in Great Britain, particularly in smaller cities such as York and Cambridge, England, which have extensive networks of bicycle lanes and paths. Bicycle lanes are commonly narrow; some were observed by a study team to be 3 feet wide or less in many cases, as shown in figure 23-13. Along some city streets, contra-flow bike lanes exist, that is, one-way bicycle lanes move in the opposite direction to one-way motor vehicle traffic (see figure 23-15). Double yellow lines next to the curb mean no parking.

*Figure 23-14. Illustration of bike shelters used in Germany.*

Bicycle trails are found in some areas of Great Britain, which allow for long-distance cycling separate from motor vehicles (see figure 23-16). Entrances onto these trails are designed to prevent most types of motor vehicles (including motorcycles) from entering (see figure 23-17). Such barriers cause some problems for bicyclists who enter or exit the trail. Bicyclists are also allowed to use an extensive network of exclusive bus lanes throughout London. In York, an abandoned rail line became an excellent bicycle facility using the existing bridges and underpasses. A 1,000-mile cycle route network for London is planned over the next several years.

## 23.4 References

Text and photographs for this section were taken from:

*FHWA Study Tour for Pedestrian and Bicyclist Safety in England, Germany, and The Netherlands,* FHWA-PL-95-006, 1994.

*Figure 23-15. Contra-flow bicycle lane in Cambridge, England.*

*Figure 23-16. Bicycle trail on an abandoned railroad right of way south of York, England.*

*Figure 23-17. Entrance to bicycle trail is designed to restrict entry by motor vehicles.*