Bicycle Network Planning & Facility Design Approaches

in the Netherlands and the United States

FHWA Global Benchmarking Program

U.S. Department of Transportation
Federal Highway Administration

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This report explores similarities and differences in the approach to bicycle network planning and facility design in the Netherlands and the United States. A very brief historical overview is provided as context for a discussion about bicycle planning and design approaches and physical infrastructure "on the ground," as observed during a visit to the Netherlands in August 2015. Following a high level discussion of respective design approaches, this report highlights four specific areas, or themes, observed in practice in Holland that are applicable to transportation practice in the U.S.

This study was conducted under the Federal Highway Administration Global Benchmarking Program (GBP). The GBP serves as a tool for accessing, evaluating, and implementing global innovations that can help FHWA respond to U.S. highway challenges. Instead of re-creating advances already developed by other countries, the program focuses on acquiring and adopting technologies and best practices already available and used abroad. This is accomplished by connecting FHWA technical experts, either directly or indirectly, with transportation advances around the world and with the people involved in applying them. The program also provides structured implementation support to facilitate the implementation and/or adaptation of promising findings in the U.S. context. Ultimately, the goal of the GBP is to help avoid duplicative research, reduce overall costs, and accelerate improvements to our transportation system.

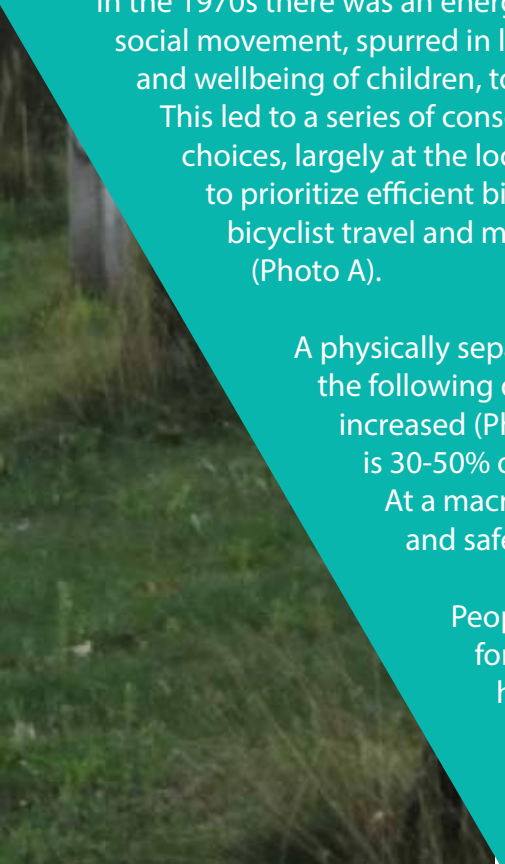

KOOPZONDAG

Historical Context

Bicycling has long been an element of Dutch culture. However, the seamless integration of bicycle infrastructure into the transportation system and the explosion of bicycle ridership evident in cities across Holland today was not necessarily preordained. Large swaths of transportation infrastructure were destroyed during the Second World War, and in the immediate aftermath much of it was rebuilt to accommodate motor vehicles.

The transportation infrastructure and people's habits in many ways increasingly mirrored the United States. People in Holland began to drive more and transportation-related injuries and fatalities crept up throughout the 1950s and 1960s.

In the 1970s there was an energy crisis and an organized national social movement, spurred in large part by a concern for the safety and wellbeing of children, to rebalance the transportation system. This led to a series of conscious policy, budget, and design choices, largely at the local and regional (i.e. provincial) level to prioritize efficient bicycle travel and physically separate bicyclist travel and motor vehicle on certain types of roads (Photo A).



A physically separated bike network took shape in the following decades and bicycle ridership steadily increased (Photo B). Today the bicycle mode share is 30-50% of all trips in many Dutch communities. At a macro level, the success of their approach and safety record is beyond debate.

People have also biked in the United States for a long time. In many communities, however, it has historically been viewed more as a recreational activity and less as a central transportation mode. Federal, state, and local governments have often prioritized efficient motor vehicle movement in the transportation planning and design process and the land area is vastly larger and more spread out in the U.S.

B

Throughout the 1970s and 1980s in the U.S., planning and design approaches and the physical infrastructure that emerged from them were heavily influenced by the vehicular cycling approach. This approach emphasizes cyclist skill development and encourages bicyclists to behave and be treated like motor vehicles. Physical accommodations tend to be wider outside travel lanes as opposed to separate dedicated space.

Since the late 1980s, in many U.S. communities there has been an increasing acceptance of the benefit of providing dedicated space for bicyclists. Initially this came in the form of striped bike lanes and in more recent years there has been a push to provide physical separation between moving bikes and cars. This physical separation makes bicycling more comfortable for a broader cross section of people. While some leading communities are now observing upwards of 10% bicycle mode share, by and large bicycling represents a small fraction of this in large swaths of the U.S.

Design Approaches

C

This historical context provides the framework for the design approach evident today in each respective country. The Dutch design approach focuses on maximizing the efficiency of the transportation system. Every person should be able to choose the most efficient way to get around and to the extent that bicycling is the most efficient option for many, designers prioritize it.

In the Netherlands bicycling tends to be viewed less as a lifestyle or a way to improve the environment and more as a logical transportation choice. Because of the focus on efficiency, in bike planning and design, emphasis is placed on smooth and seamless routes and minimal stopping (Photo C).

There is an implicit assumption in Holland that on roads with higher volumes of cars traveling at faster speeds, it is always preferable to separate bicycle and motor vehicle movement because it is safer and more comfortable. Specifically, in the Netherlands when motor vehicles are traveling faster than around 19 miles an hour, it is assumed that separation is needed.

This is accomplished, in large part, by developing distinct bicycle, motor vehicle, and transit networks and accepting that all modes cannot be served on all streets equally. Separate modal networks also facilitate the creation of long linear bike routes and minimal stopping to achieve the underlying efficiency goal.

The big picture network focus is balanced by a 'sustainable safety' design approach that emphasizes good visibility, slowing turns, and limiting the speed differential between bicyclists and motor vehicles (Photo D).

Motor vehicle speed is controlled by visual narrowing techniques and grade differences and less emphasis is placed on signage and striping. With cars and bikes traveling at slower speeds, there is greater ability to allow for informal mixing, for example on shared streets and at points where two bike routes cross each other (Photo E).

Informal mixing strategies require greater trust in the users of the transportation system and rely more heavily on eye contact, active awareness of all travelers, and high bicyclist skills levels (achieved in part by bicycle safety education and training provided at a young age). It also helps that people driving often have a history of bicycling themselves and so prioritize watching for bicyclists

while they are driving or opening car doors. Dutch approaches to traffic laws also provide more protection for bicyclists than is typical of the U.S.

The U.S. design approach places greater explicit emphasis on safety. In an effort to maximize safety, designers often attempt to remove as much potential conflict as possible. This results in signal protected turn movements through intersections that decrease interaction (potential conflict) but also add travel delay for all users. Motor vehicle drivers tend to be traveling at higher speeds so there is less trust in their ability to informally mix with other modes. There is less emphasis on eye contact and user skills (in large part because there are fewer educational and training opportunities) and more emphasis on designing to direct behavior as much as possible.

A greater emphasis is placed on consistent signage and striping. In part because of the value placed on consistency and in part because of a real and perceived difference in liability, a greater emphasis is placed on design guidelines in the U.S. These design references are treated more as requirements and less as inspiration or sources of ideas.

At the project level in many U.S. states and cities there has been an increased emphasis on adopting complete streets policies, or related approaches to accommodate all modes on projects. The concept of bigger picture regional network connectivity often tends to be less prominent. Individual property rights are often a central consideration in the U.S. planning context. As a result, changes to policies and regulations, for example relating to access management, are assumed to be more difficult. There tends to be less willingness to add motor vehicle delay in the system. Because of these issues, and the fact that in many communities there are not a lot of people walking and bicycling on roads today, pedestrian and bicycle accommodations in the U.S. are often not included or addressed with network creation in mind.


Heineken

Lessons Learned

The following section outlines general themes resulting from an FHWA staff visit to the Netherlands in August 2015.

1. Prioritize Seamless and Efficient Bicycle Movement

Bicycling in Holland is a remarkably smooth and efficient mode of travel. Long linear stretches of separated bicycle facilities make it efficient to travel from one side of town to the other (Photo F). Efforts are made to minimize stops for bicyclists, which were likened to adding 200 or 300 meters to a bicyclists' journey depending on the amount of delay.

Separate pedestrian facilities and relatively few driveways decrease potential modal conflict and minimize bicyclist delay. Separate bike signals and signal priority (including double signal phases) push large volumes of bicyclists through intersections. There appears to be less emphasis on bike turn signals, so more time in the cycle can be dedicated to bike through movement (Photo G). At the same time, not a lot of unprotected turn movements were observed (Photo H).

At locations where a shared use path crossed a road, there appears to be greater acceptance of using unsignalized crossings. A median island often enabled the bicyclist to cross one side of the road at a time and the lack of a signal meant that bicyclists could cross with little delay.

Informal mixing strategies often tended to minimize delay. They're based on the notion that when speed differential is minimized, modes can interact safely and with fewer regulations and that bicyclists and drivers will behave rationally if the system is designed well (Photo I).

The prioritization of efficient bike movement is also apparent in construction zone routing techniques. Temporary paved trails and fully separated bike lanes are regularly provided because bicycling is seen as transportation rather than recreation. A high quality temporary route often obviated the need for detailed directional signage and route finding (Photo J).

G

H

I

Roundabouts enabled bicyclists to navigate large intersections, often without ever stopping or dismounting. Taken together these techniques make bicycling the fastest and most convenient option for getting around.

2. Trust in Users and in the Adaptability of the Transportation System

Trust appears to play a more prominent role in the Dutch transportation system. Transportation practitioners trust that motor vehicles, bicyclists, and pedestrians can interact safely in the same space on a shared street under appropriate conditions (Photo K).

J

Mopeds can share space with bicyclists on a bike path and they both can navigate around pedestrians crossing the path. Electric bicycles, which can travel faster are also getting popular in Holland and share space with other bicyclists. Eye contact, visibility, well trained bicyclists, and a belief that people will behave rationally are cornerstones of the design approach (Photo L).

This works when speed differential is minimized and it requires that people are engaged in and aware of their surroundings. It helps that bicyclist skill level is high (quick controlled maneuvers were observed to avoid conflict) and it also helps that most drivers are attuned to bicyclists' needs.

K

There is also trust in the adaptability of the system. If a shared street is congested for much of the day, businesses will simply arrange delivery and loading early in the morning. It's rational to avoid the congested times because that adds delay. Similarly, if a shared street is congested with pedestrians, bicyclists will travel slowly out of necessity (not because of warning signs) and if they want to move faster they will choose a different route. The system adapts and adjusts in ways that don't always require active intervention on behalf of transportation practitioners.

3. Design for the Behavior You Want to See

The Dutch transportation system appears to place more trust in the people using it, but this trust is not blind. Dutch practitioners work to create a physical environment that fosters efficient and safe individual behavior that leads to efficient and safe systems.

L

The design process begins with the assumption that well designed infrastructure will intuitively shape and influence behavior (Photo M). In contrast, the American approach often focuses more on using signage and enforcement rather than intuitive or self-explaining roadway design to naturally promote safe behavior. The Dutch approach focuses energy on the desired behavior (i.e., user cooperation), while the American approach often focuses energy on the undesirable behavior.

M

Desired behavior is often achieved through intuitive and subtle design cues and for this to succeed, intuitive user recognition is key. For example, Dutch design relies heavily on visual narrowing techniques to calm traffic. Most Dutch bicycle lanes are indicated by red pavement which creates a visual narrowing of the road (Photo N).

Another way to accomplish this is through alternative patterns of pavers that focus the field of vision and limit broad expanses of pavement (Photo O). Vehicles turning across a path or sidewalk regularly and consistently experience a grade change (e.g., via raised intersections) and this automatically slows down cars at potential conflict points (Photo P). Emphasis is placed on visibility and limiting speed differential between modes.

N

O

Taken together these features promote the desired behavior and enable the trust that is placed in users. The design process focuses more on behavioral and safety outcomes and less on regulation and enforcement.

4. Prioritize Network Connectivity

Maximizing the efficiency of bicycle travel is a cornerstone goal of the Dutch design approach and this can only be achieved by taking a broad system level perspective. Car, transit, and bicycle planning are done together given that all modes need to be accommodated within one system; however, this does not necessarily mean that all modes are accommodated on all streets.

P

Car, transit, and bike network plans are identified and modal priorities are established that guide decisions about trade-offs. Planning for multi-modal trip chaining and transport integration are emphasized given each modes role in supporting and reinforcing other modes, so for example bike parking at transit stations is prioritized.

These decisions get formalized into what is a very clear functional hierarchy of streets. On neighborhood roads, cars travel slowly and often share space with pedestrians and bicyclists (Photo Q). On collector roads, bicyclists have a separate dedicated space parallel to the road to maximize efficiency of movement (Photo R), and on

Q

R

roads with faster traffic, bicyclists typically have a shared use path separate from the road (Photo S). This hierarchy is uniform, logical, and predictable.

Each corridor plays a role in the transportation network and the system only works if people can efficiently get where they need to go regardless of what mode they choose. Pedestrian and bicycle bridges throughout the network (Photos T & U) ensure that large roads and natural features such as waterways don't create barriers. A system wide network perspective makes design decisions for specific corridors more straightforward, and it begins with a fundamental agreement that every mode will be accommodated (Photo V). It was described as a complete city and complete networks approach.

T

U

S

V

Conclusion

The Dutch design approach emphasizes efficiency of bicycle movement. Intuitive user recognition of design cues enables designers to influence positive behavior and place less explicit emphasis on safety in the design process. Design guides are used as inspiration not as limiting factors in the design process and the result is bicycle networks that adapt to and accommodate observed behavior and enable efficient bicycle movement.

Much of the Dutch design approach can be adapted to U.S context. In fact, some common facilities in Holland, such as separated bike lanes and novel intersection designs, are being implemented in the U.S. The recent implementation of such facilities demonstrates that aspects of the Dutch design philosophy can work in the U.S., too. The principles of seamless movement, trust in users, designing for behavior, and prioritizing network connectivity can work in the U.S. context. FHWA aims to help stakeholders use these principles to make bicycling safer and more comfortable.

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