February 2013

Best Practices White Paper #3: Bicycling Solutions for Hilly Cities

Seattle Bicycle Master Plan Update

Introduction

Seattle's challenging topography is a barrier to some current and potential bicyclists. In past and recent outreach efforts in Seattle, many residents cite hilly terrain as a barrier to riding a bike. In order to navigate between neighborhoods and in and out of downtown Seattle, bicyclists will encounter significant topographical changes throughout the city. Hilly terrain can be particularly challenging for less experienced riders, seniors and families. People riding bikes may note challenges with the following:

- Cycling skills – concerns about maintaining control on steep terrain
- Level of fitness – concerns that the steep terrain will make cycling too challenging or uncomfortable
- Appearance/ Perspiration – concerns about appearance and wearing professional attire for commuting, etc.
- Motorists' skills – concerns about unsafe conditions from motorist inattention or lack of control on hills

Developing facilities that minimize the challenges posed by the existing terrain will support increased bicycling in Seattle. This white paper identifies potential solutions for minimizing the negative impact of hills on people riding bikes. The paper is organized with a brief problem statement and solution, which is then followed by case studies and examples of specific solutions from other communities.

Prioritize Connections and Routes without Hills

Seattle's hills are one of its defining characteristics, and pose a significant challenge to anyone commuting with their own two legs. This unique geography naturally creates high-demand arterials beside waterways and at the base of valleys. Historically, major arterials are routed on some of the straightest and flattest corridors in the city. There may be no good alternative for a bicycling route that does not require significant hills or out of direction travel. Building safe facilities on these corridors can be difficult with the competition from other modes.

In some cases, requiring bicyclists to cover hilly terrain is inevitable. However, it is important that bicyclists and pedestrians are given the highest priority on the flattest routes.

Solution:

Prioritize bicycle connections that minimize elevation changes and provide direct connections. If the only alternative to a busy arterial is a very steep grade, then the arterial should be treated aggressively to allow comfortable and safe cycling on the most desirable route.

Route prioritization is a high level policy decision and should guide network development. In Seattle, route development must address the grade of the street wherever possible, and consider the impacts that grade has on automobiles versus bikes and pedestrians.

RETROFITTING ARTERIALS
Chicago, Illinois

The City of Chicago has embarked on an ambitious plan to provide improved bikeways on arterial streets. In the last year the City has established buffered and/or protected bike lanes on eight major streets.

While many of these corridors were 'low hanging fruit' with relatively low traffic volumes and right-of-way available, the investment in infrastructure is having immediate impacts.

Kinzie Street, the City's first new projected bike lane project, features three main elements: a marked lane adjacent to the curb in each direction along Kinzie; a buffered area with flexible marker posts, and a parking lane for automobiles. Green paint and pavement markings depicting a bicycle help further define the lane. Further the project included custom-fitted plates that cover the Kinzie Bridge's open-grate deck to create a smooth riding surface. This last piece of the project greatly improved a pinch point for cyclists.

The new lane proved popular with bicyclists almost immediately. The initial bike mode share in the corridor was around 22% of peak traffic. About a month after completion of the facility bicycles accounted for 48% of peak traffic.

The City now will tackle some of its more challenging corridors where limited space will require significant trade-offs.

SELECTING THE FLAT ROUTE
Fell Street - San Francisco, California

Fell Street is a one-way arterial, 48'9" wide that serves as the westbound leg of a couplet with Oak Street. Fell Street has three full time westbound lanes with a 4-6PM tow-away lane along the south curb. The street carries approximately 38,000 vehicles per day (2002 count), including 2 express bus lines during the PM peak.

Despite the high volumes of traffic, the higher speeds, and the lack of bicycle facilities, cyclists find this street a desirable alternative to existing bike routes in the area due to its flat, direct connections to other primary bike facilities such as the 'Wiggle' and the Panhandle Path. Existing routes in this corridor are less ideal with steeper grades and less direct connections to the Panhandle Path.

In 2002, Fell Street was resurfaced and restriped so that the tow-away lane along the south curb was widened from 10'9" to 12'. During non-PM peak hours, this widening provided cyclists with 5' of space next to a 7' wide parking lane. For the 10 hours a week that the tow-away was in effect, cyclists shared the 12' wide south lane or 10'9" wide north lane with motorists.

While this was a slight improvement it did not provide the level of service for bicycles needed in the corridor. Over half of the cyclists counted during a PM peak survey opted instead to illegally use the sidewalks along Fell Street.

Since 2002 a number of proposals to improve the street for bicycles have been suggested. Given that this route is a vital connection for multiple modes, the San Francisco Municipal Transportation Agency (SFMTA) has developed a design that includes overall streetscape improvements that will support pedestrians, bicycles and transit.

Proposed project elements include:

- Cycle tracks that are separate from motor vehicle traffic
- Corner bulbouts to shorten narrow the roadway
- Neighborhood greening – street trees etc.
- Curb ramp upgrades
- Crosswalk enhancements
- "Day lighting" intersections to improve visibility of pedestrians
- Traffic signal enhancements for pedestrians and cyclists
- Bicycle parking
- Bus stop consolidation to improve muni efficiency

Additional information about the project available at:
http://www.sfmta.com/cms/bproj/OakandFellBikeways.htm

Help People Avoid Hills

While out of direction travel is typically not the first choice of cyclists, routing to avoid steep grades can be desirable. A low elevation gain route supports cyclists with a wide range of abilities. For example, families and new cyclists will be more likely to take a slightly longer route to avoid steep grades, and these routes may also serve stronger riders when carrying cargo.

Solution:

Develop user maps and wayfinding to help residents and visitors choose lower-hill routes if that is a priority for them. Seattle is already showing information about steep grades on existing user maps and information materials. This can be expanded to provide suggested route maps for lower elevation gain routes and on roadway wayfinding.

'THE WIGGLE' San Francisco, California

The Wiggle is a one-mile, zig-zagging bicycle route from Market Street to Golden Gate Park in San Francisco, California, which minimizes hilly inclines for bicycle riders. Rising 120 feet (37 m), the Wiggle inclines average 3% and never exceed 6%.

Bicyclists can travel the Wiggle between major eastern and central neighborhoods (such as Downtown, SoMa, The Mission District, The Castro) and major western neighborhoods (including the Panhandle, the Haight, Golden Gate Park, and the Richmond and Sunset Districts).

The Wiggle was never planned as a specific route, but rather is a combination of a few routes that were stitched together over time by cyclists. There are now wayfinding signs and maps that show the route of 'the wiggle,' and it has become a source of city pride along with the city's iconic hilly topography.

Build the Right Facilities for Hills

While it is a worthy pursuit to try to minimize hills, it is not possible to avoid them altogether in Seattle. Facilities should address cyclist behavior and needs on hills. Behaviors and conditions to address include the following:

- Speed differential – between different cyclists and between cyclists and motorized vehicles in the uphill direction. Cyclists may travel at speeds equal to motorized vehicles in the downhill direction.
- Weaving – steep grades may require more space for cyclists to travel in a weaving, or switch-back, pattern.
- Passing – traveling uphill and downhill segregate riders by their speeds more so than flat terrain, resulting in a higher demand for passing lanes.
- Starting on an uphill – cyclists often have to stop at a light in the middle of a hill climb, resulting in an uncomfortable start once the light turns green. Providing sufficient space for cyclists to begin biking again at these intersections is key.

Seattle currently uses a paired uphill climbing lane and downhill shared lane markings (described on the following page) to minimize the impact of slope on cycling. Seattle's current guidance recommends that a climbing lane be employed when roadway grades exceed 4 percent for at least 300 feet.

Solutions:

Wider Bike Lanes
Wider and expanded uphill bikeways can accommodate both weaving and speed differentials between cyclists of varying abilities. A standard bike lane is 5 to 6 feet wide. This is safe for operation of a single bicycle, and leaves a bit of a buffer to maneuver around road debris, stationary obstacles, or motorized vehicles infringing on bike lanes. While the space required for a bicycle is consistent for most users, the speed preference is highly variable between users.

Two solutions for a wide bike lane include the following:

Bicycle Passing Lanes: Second bike lane added adjacent to the first to provide ample space for passing.

Buffered Bike Lanes: Bicycle lane with a buffer to increase the space between the bicycle lane and auto travel lane or

SDOT is already experimenting with standard and buffered bike lanes in uphill locations

parking.

Uphill Bike Lanes

The right-of-way or curb-to-curb width on some streets may only provide enough space to stripe a bike lane on one side without removing travel lanes and/or on-street parking. Under these conditions, bicycle lane striping could be added to the uphill side of the street only.

Bicyclists ascending hills tend to lose momentum, especially on longer street segments with continuous uphill grades. This speed reduction creates greater speed differentials between bicyclists and motorists, creating uncomfortable and potentially unsafe riding conditions. By separating vehicle and bicycle traffic, uphill bike lanes (also known as "climbing lanes") enable motorists to safely pass slower-speed bicyclists, thereby improving conditions for both travel modes. Uphill bike lanes can be combined with shared lane markings in the downhill direction, where bicyclists can match prevailing traffic speeds. Seattle has multiple locations with uphill bikes lanes and will continue to use them where appropriate.

Slower Auto Speeds

Reducing the overall speed differential on hills can make cycling more comfortable in both the uphill and downhill direction. Where routes must include steep grades, a reduced speed limit for motorized vehicles can reduce the speed differential. In general, a speed differential between motor vehicles and bicyclists of 15 mph or less is desirable to reduce turning conflicts, number of passing events, and severity of collisions.

Bike passing lane on the Hawthorne Bridge in Portland, OR

BICYCLE PASSING LANE Portland, Oregon

The Hawthorne Bridge is a primary crossing of the Willamette River that connects the east side residential areas to downtown Portland. It carries upwards of 8,000 cyclists per day. From the east side, there is one primary entrance to the bridge that includes an uphill approach.

With a significant volume of cyclists and notable speed differential between cyclists on the incline, the typical lane width of 5 feet was inadequate. Higher speed cyclists were forced to stack up behind slower moving riders or move out into the travel lane with motorized vehicles to pass.

The solution to the problem was a short segment of bicycle passing lane where a second lane was added to the left to allow for passing. The side-by-side lanes last until the crest of the grade.

The Portland Bicycle Plan for 2030 gives high level guidance for when to consider the development of a bike passing lane.

Summary of Facility Solutions:

Uphill Bicycle Climbing Lane

Description

Uphill bike lanes (also known as "climbing lanes") enable motorists to safely pass slower-speed bicyclists, thereby improving conditions for both travel modes.

Guidance

Uphill bike lanes should be 6-7 feet wide (wider lanes are preferred because extra maneuvering room on steep grades can benefit bicyclists).

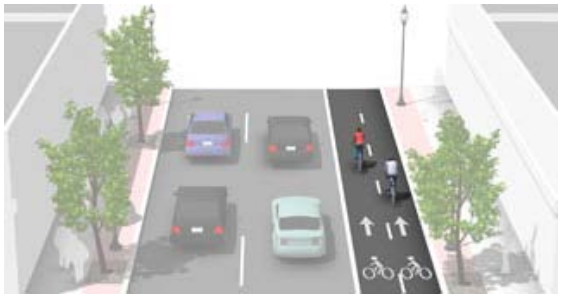
Can be combined with Shared Lane Markings for downhill bicyclists who can more closely match prevailing traffic speeds.

Discussion

This treatment is typically found on retrofit projects as newly constructed roads should provide adequate space for bicycle lanes in both directions of travel. Accommodating an uphill bicycle lane often includes delineating on-street parking (if provided), narrowing travel lanes and/or shifting the centerline if necessary.

Example Seattle locations: Stone Way N between N 50th Street and N 34th Street and Yesler Way between Broadway and 4th Ave

Bicycle Passing Lane



Description

Adding a second bike lane adjacent to a first to provide space for passing

Guidance

Allow adequate space for two bicyclists to pass without encroaching into the travel lane. Minimum passing lane width of 5 feet adjacent to a 5-foot bike lane.

Skip striping between the two bike lanes and double bike symbols mitigates concerns of motorists mistaking the area for a travel lane.

Discussion

This treatment is helpful where the following conditions are present:

- Large number of cyclists
- Wide range of cyclist travel speeds
- Uphill roadway

The use of the passing lane reduces the length of bicycle platoons in congested areas and reduces number of faster bicyclists that merge with auto traffic to pass slower cyclists.

Buffered Bike Lane

Description

Conventional bicycle lanes paired with a designated buffer space, separating the bicycle lane from the adjacent travel lane and/or parking lane.

Guidance

Where bicyclist volumes are high or where bicyclist speed differentials are significant, the desired bicycle travel area width is 7 feet. Buffers should be at least 2 feet wide. If 3 feet or wider, mark with diagonal or chevron hatching.

Discussion

Buffered bike lanes are designed to increase the space between the bike lane and the travel lane or parked cars. Frequency of right turns by motor vehicles at major intersections should determine whether continuous or truncated buffer striping should be used approaching the intersection. Commonly configured as a buffer between the bicycle lane and motor vehicle travel lane, a parking side buffer may also be provided to help bicyclists avoid the 'door zone' of parked cars.

Help People Get up Hills

In some areas of the City the slope may be too steep to cycle or people simply want an alternative. A comprehensive approach to addressing hills should include opportunities to combine cycling with other modes and utilize design and technology to minimize the impact of the slope.

Solutions:

Transit Integration

In addition to helping cyclists overcome hills, bicycle/transit integration can overcome other obstacles to bicycling, including distance, riding on busy streets, night riding, inclement weather, and breakdowns.

Key elements for successful integration include the following:

- Provide direct and convenient access to transit stations and stops from the bicycle network.
- Provide safe and secure long term parking at transit hubs.
- Provide maps at major stops and stations showing nearby bicycle routes.
- Provide wayfinding signage and pavement markings from the bicycle network to transit stations.

Folding Bicycles

A folding bicycle is a bicycle designed to fold into a compact form, facilitating transport and storage. When folded, the bikes can be more easily carried into buildings and workplaces or on public transportation. Folding bikes become a viable hill solution for bicyclists when combined with other modes.

The compact size gives folding bicycles distinct advantages over conventional bicycles for multi-mode commuting. For example, most conventional bus bike racks can carry two to three bikes at a time. At peak periods, racks can be full, requiring riders to wait for an empty space on the next bus or choose an alternative. The ability to consistently bring the bicycle on board provides consistency and improves reliability for commuters.

Given the benefits of combining transit and bicycles, many transit agencies, including King County Metro, have officially welcomed the use of folding bikes. Transit agencies in communities such as San Francisco, Pittsburgh (Allegheny County), and Los Angeles County have established policies that explicitly allow folding bikes aboard buses, trains and streetcars.

FOLDING BIKE IMPLEMENTATION PLAN
Los Angeles County, California

Los Angeles County realized the potential for folding bikes to help transit users with the last mile problem on both ends of their trip. In an effort to support folding bikes, the County worked with a consultant to develop a conceptual planning document that summarizes key issues for using folding bikes for transit integration.

A component of the project included a market analysis to understand the perceptions of and interest in folding bikes from existing transit users.

Key findings include:

- Public survey results indicate that offering a cash buy down on the purchase price of a folding bicycle is likely to be the most effective incentive for end users.
- Portability is the most important attribute of a folding bike when used in conjunction with transit.
- It is important that bikes are available for purchase from local vendors to ensure a high level of service and support
- Residential density, the level and quality of nearby public transit, and the level of bicycle friendliness are effective indicators for determining levels of bicycle usage in a given community
- The majority of surveyed transit riders are generally aware of folding bicycles but do not fully recognize their value given that few would pay more than $200 to purchase one. In order to effectively stimulate the folding bike market, early cash incentives should bring down the purchase price to users' expectations

The complete implementation plan document is available at:
http://www.calstart.org/Libraries/Publications/Folding_Bike_Implementation_Plan.sflb.ashx

Electric Bicycles

While electric bicycles are not as likely to combine with other modes, the technology makes it easier for cyclists of all abilities to overcome hills. Electric or e-bikes are bicycles that have an electric motor that assists, but does not replace, the power provided by the rider. They are not motorbikes, the rider still needs to pedal with the motor providing extra help that can be useful when starting from a stop and going up hills. Some qualitative research on the use of e-bikes indicates that older adults and riders with some physical limitations may find them an attractive option.

In the past e-bikes have not had broad appeal in the US. Past models on the market resembled mopeds and were not always easy to purchase or service. Distribution channels of electric bicycles are not as developed and the majority of bike shops do not sell electric bikes. In addition, e-bikes in general are a relatively immature technology with lingering concerns about reliability and ease of use.

However, newer products in the market are attractive, look more like regular bikes, are easy to operate, simple to maintain, and feature high quality components. More retailers are stocking e-bikes and making it a significant feature of their shop. With an increased presence of e-bikes, it is also easier to get service and maintain the bike.

New research and pilot projects are exploring the potential of this new generation of e-bikes. As technology and availability of e-bikes improves their use by a broader population will likely increase.

CYCLEUSHARE
University of Tennessee-Knoxville, Tennessee

CycleUshare is a pilot program to test the merging of two technologies, e-bikes and bicycle sharing. The program is available to 125 students, faculty and staff on the large and hilly UTK campus. Currently, there are two station locations; each station has the capacity for ten bicycles, including seven e-bikes and three regular bikes. In the first year of study, it was found that walking was the most commonly replaced mode and 22% of users accounted for 81% of trips.

http://www.cycleushare.com/
http://cycleushare.blogspot.com/

EVALUATION OF ELECTRIC BIKE USE IN PORTLAND METRO REGION
Portland State University, Oregon

Researchers at Portland State University are currently undergoing a research project on e-bike use in the region. The research project has two primary objectives: (1) Understand people's perceptions and attitudes of e-bikes; and (2) Evaluate the use of e-bikes by potential users to determine if these bikes could encourage new bike users. It is anticipated that this research may provide valuable insight into the potential market, user characteristics and barriers to adoption. The results of this research will be available in late 2013.

http://otrec.us/project/564

Bicycle Stairway Runnels, Channels and Elevators
A bicycle stairway is a pedestrian stairway which also has a channel alongside or in the middle to facilitate walking a bicycle up or down the stairway. Although many names exist for this facility, in Seattle, it is referred to as a runnel. The runnel is intended to guide a variety of bicycle tires without binding or causing damage. Cross-section shapes of the runnel vary, but are usually either nearly rectangular or V- or U-shaped.

Since 2007, SDOT has improved their stairway standard to include a bike runnel. Starting in 2011 and continuing in 2012, major stairway rehabilitation projects have considered installing runnels. Five runnels have been installed through June 2012, with up to three additional runnels installed by the end of 2012.

Careful attention should be paid to design of bicycle runnels. Accessibility requirements for handrails can conflict with bicycle stairways, as handrails may obstruct or decrease the control of the bicycle.

Bike Sharing
Public bike sharing systems are comprehensive mobility systems that use a fleet of bicycles and stations spread over an area to provide inexpensive and accessible transportation to primarily urban communities. They are well-suited to short trips, typically 2-3 miles or less.

Bike sharing has the potential to support people in taking additional trips by bicycle. The option of one way trips without the need for bicycle storage provides flexibility to combine bicycling with transit or other modes to avoid or minimize major hills in Seattle. Placement of stations and system balancing can be strategic to allow riding in the downhill direction and transit or another mode in the uphill direction. Puget Sound Bike Share, a non-profit, will launch a bike sharing system in Seattle spring 2014.

CAPITAL BIKESHARE Washington, DC

Capital Bikeshare current has a fleet of 1670+ bicycles with 175+ stations across Washington, D.C. and Arlington, VA.

There is evidence that bike share users tend to use the system more often in the downhill direction. System operators keep an ongoing record of those stations where more bicycles are checked out by users than returned by users. These stations are 'net senders' meaning that operators must continuously rebalance that station since the station loses bikes over time.

Of the top 10 stations that send more bikes than they receive, nine are at the top of hills. The one station that is not at the top of a hill in a recent analysis the top 25 'net sender 'stations were in the higher elevation areas of the city.

Capital Bikeshare is widely used to access to transit. In a recent survey, more than half of all respondents used Capital Bikeshare to get to or from a Metrorail station. In addition about two in ten used Bikeshare to access a bus stop.

VISIONARY HILL SOLUTIONS
Oregon Health and Science University – Portland, Oregon

Aerial Tram

The Portland Aerial Tram carries commuters between the city's South Waterfront district and the main Oregon Health & Science University (OHSU) campus, located in the Marquam Hill neighborhood. The tram travels a horizontal distance of 3,300 feet and a vertical distance of 500 feet in a ride that lasts three minutes. The alternative to riding the tram is roadways that require a 1.9-mile route with numerous stoplights and large intersections. The route includes a short stretch of busy U.S. Route 26, as well as winding Sam Jackson Park Road, which ascends the side of the Tualatin Mountains to the OHSU campus.

Packed bike parking at the base of the tram

The steep hill climb on a street with significant traffic volumes is a major barrier to cycling for hospital and university staff and students. Within a year and a half of opening, the tram hit one million riders. The base of the tram initially had around 300 spaces for bike parking. It was quickly determined that there was significant demand beyond those spaces.

OHSU added a high capacity valet parking system that created an additional 200 spaces and allowed expansion of the self-parking area. There are now approximately 550 spaces that are 90% full during peak use periods on Tuesday through Thursday. An additional 130 spaces are located in less visible areas in parking garages and buildings near the tram. These lower visibility parking areas are approximately 50% full during peak use periods.

The current racks are held down by gravity and the valet is capable of quickly adjusting their setup, so capacity can vary. While the tram is a somewhat extreme example of bicycle and transit mixed mode commuting – it provides a visionary solution to the challenge of hills and connectivity.

Gibbs Street Bridge Elevator

The Gibbs Street Pedestrian Bridge, more formally known as the *US Congresswoman Darlene Hooley Pedestrian Bridge at Gibbs Street*, is a 700-foot pedestrian/bicycle bridge which opened in July 2012. It connects the Lair Hill neighborhood with the South Waterfront area just south of downtown Portland.

To compensate for the 70-foot elevation difference at the ends of the bridge, an extra wide elevator cab with front and back doors was installed as well as a stairway with a bicycle 'channel' to serve the five-story height. The 132-step stairway includes rest areas. The design of the bicycle runnel has not been well received by cyclists. Accessibility requirements for handrails can conflict with bicycle stairways, as handrails may obstruct or decrease the control of a bicyclist using the channel. In addition, the current design lacks a typical V or U shaped channel which helps bicyclists in directing their bicycle wheel when using the channel.

While neither the elevator nor the tram was constructed to serve cyclists specifically – the design and additional accommodations are benefiting cyclists. These two projects in the South Waterfront area are dramatic examples of advanced solutions to that overcome hill and elevation barriers.

Embrace the Hills

The hilly terrain and waterways of Seattle are part of the pride and culture of the city. Two of the nation's top five large cycling cities, Seattle and San Francisco, are also among the hilliest.

Solution:

There are examples from around the country and globe of communities that have made the case for celebrating the hills and actively promoting creative solutions.

The Wiggle is a marketing tool for San Francisco. In Pittsburgh the local advocacy group Bike Pittsburgh embraces the hilly terrain with promotional stickers. Current rides, races and hill climbing events in Seattle and the Puget Sound region revel in the hilly terrain.

While hills are a real physical barrier to cycling, promotion and encouragement can work in combination with infrastructure solutions to overcome the psychological barrier. Seattle is already known for its active population, recreating in the multiple mountain ranges and waterways around the city; promoting hill climbing on bikes should be no problem.

Hills can be promoted and embraced as part of the city's approach to wellness. Hill workouts are touted for building fitness for everyone from professional cyclists to senior walking groups.

Neither rain, sleet or hills has stopped Seattle residents from turning to the bicycle for transportation in greater numbers

CASE STUDY FOR A COMPREHENSIVE APPROACH TO HILLS

Lausanne, Switzerland

Lausanne is the fourth largest city in Switzerland, with 130,000 residents in the city and 300,000 in greater Lausanne. Situated on the shores of Lake Geneva, the City rises sharply from the lake at about 400 meters to 900 meters, a difference in elevation of about 500 meters (1,640 ft.) between the lakeshore at Ouchy and its northern edge bordering Le Mont-sur-Lausanne and Epalinge.

The city has gone to great lengths to plan for and encourage cycling despite the challenging topography. The city has identified specific actions to improve options for cycling in four key areas:

- Bicycle supportive transportation and land use planning
- Appropriate infrastructure
- Combined solutions (transit and bike share)
- Encouragement and promotion

Specific examples of actions to support cycling throughout the city include the following:

- Bike and Ride planning for transit integration (bike parking, bikes on trains and buses, bike share)
- Moderated vehicle speeds in identified areas
- Lane width redistribution according to the scope, reconfigures travel lanes to allow for an uphill bike lane on one side
- Contra flow bike lanes based on slope direction, developed to avoid steep inclines
- New bicycle/pedestrian bridge to connect two high points in the city
- Three new elevators to connect two levels of the city center
- Bike lanes and bus lanes on sloping streets (Cycle track in the uphill direction and shared bike/bus lane in the downhill direction)
- Bike sharing
- Educational materials promoting the use of folding bikes on transit
- Cycling map that highlights steep slopes and bike connections to transit

Summary presentation from Velo City available at:

http://shoploppen.dk/Velo-city_presentations/Jean-Christophe%20Boillat.pdf

Key Recommendations and Opportunities

Seattle has steep terrain and significant natural barriers that make bicycle route connectivity challenging. In order to make the bicycle network safe and comfortable for a wide variety of cyclists, SDOT will need to make overcoming hills a significant focus of network development, facility design, education and encouragement.

No single method for addressing hills will overcome the challenges. A comprehensive approach will be necessary to overcome hills as an impediment to increased cycling among residents of Seattle. This discussion highlights four specific strategies drawn from solutions introduced in this white paper. The strategies should be used in combination and inform the master plan process:

Support Development of the Best Routes and Facilities through Policy

SDOT should be clear in their intent to minimize the hills as a barrier to cycling through strategic and thoughtful placement of routes and appropriate facilities. In some cases there are existing somewhat flat and connected arterial routes that will need advanced and potentially expensive solutions. Minimizing the impact of hills should be a key strategy of bicycle network development and connectivity. SDOT should consider defined objectives in the master plan to support project development on low grade roadways in the future.

Continue Innovative Infrastructure Solutions

SDOT should continue to advance innovative infrastructure solutions throughout the city. Consider buffered bike lanes, passing lanes, uphill bike lanes, and contra flow lanes as specific options for hill routes. Hill direction should be a key consideration of facility selection and design. Continue the expansion of stair runnels/channels and elevators where needed.

Coordinate with Transit Providers and Puget Sound Bike Share

Work closely with transit and Puget Sound Bike Share to support clear connections to the bicycle network and adequate end-of-trip facilities. During network development for the BMP consider access to transit with hill direction in mind.

Provide Education and Encouragement

Develop programs and information to help people avoid hills. Continue to partner with transit agencies to promote bicycle transit integration. Celebrate hills as a source of city pride.