Best Practices Literature Review: Quick-Build Bicycle Infrastructure and Mode Shift Readiness in Frisco, Colorado- [Zotero Library Link]

Introduction

Across North America and even globally, there are increasing investments being made towards bicycle infrastructure with the intentions of improving transportation, sustainability, public health, economic resilience, and climate mitigation. Research has been consistent in demonstrating that the strongest predictors of cycling participation are often correlated with infrastructure quality, network connectivity, and supportive policy frameworks (Pucher & Buehler, 2012; Winters, Buehler, & Götschi, 2017). Specific to mountain communities such as Frisco, Colorado– bicycle infrastructure plays significant roles in supporting tourism, local workforce mobility, and year-round transportation efforts and alternatives.

Frisco's Trails and Pathways Master Plan emphasizes that bicycle and pedestrian systems/networks are at the core bridging safety, accessibility, and connectivity between residential areas and the larger commercial town– along with trails systems (Town of Frisco, n.d). This literature review will investigate and aim to examine the best practices in implementing quick-build bicycle infrastructure, network connectivity, winter cycling readiness and maintenance, safety support, and infrastructure planning to support cycling mode shift. Drawing from peer-reviewed research, case studies, and professional recommendations based on current academic and media research– this literature review will identify current existing strategies that are relevant to Frisco's near-term infrastructure planning and long-term transportability goals.

Infrastructure Design and Cycling Participation

The quality of infrastructure is one of the most crucial pieces that influence cycling participation. Research shows that bicycle infrastructures that are protected increase ridership and psychological perception of safety (Dill & McNeil, 2013; Pucher & Buehler, 2005). An actual physical barrier that separates motor vehicles from bike lanes reduces crash risk and encourages participation from diverse and larger populations such as women, elders, and newer or less experienced cyclists (Winters et al., 2011).

Current studies show that individuals are significantly more likely to participate in cycling when protected infrastructure is intact and available, simply compared to painted bike lanes (Krizek & Johnson, 2006). Similarly, a study conducted by The University of New Mexico found that bike lanes that are protected increase rates of commute and the amount of perceived safety. This looks

like bike lanes protected by a physical barrier such as parked vehicles to improve cyclists' safety and comfort, increasing rider participation and riders discerning personal safety and security (Not Just Bikes, 2023). This aligns with the city of Frisco's concept of "high-comfort" as outlined in their Trails Master Plan– prioritizing the use of facilities that reduce user stress and improves accessibility (Town of Frisco, n.d.).

This research is directly reflected in Frisco's existing street geometry– which gives plenty of diversity in cross section width to offer a layered approach to the implementation of bicycle infrastructure. Collector streets such as Granite Street and 8th Avenue– which is measured at approximately 36 ft in paved width, allow the accommodation of parking-protected bike lane configurations within the currently existing pavement footprint. Travel lanes, retained parking on one side, buffer zones with flexible bollards/planting, and plentiful and dedicated bike racks are included within these designs. These types of configuration offer the highest-comfort treatments that are a result of quick-build methods and the type of physical separation that are historically linked to higher rider participation across different age and rider experience groups.

With narrower commercial streets measuring with 30 feet cross-sections and constrained bike lanes with strategic parking management plans can help support functional separation while restoring crucial parking capacity. This practice aligns well with the practice guidance of flexible allocation for street space based on certain demands and contexts (NACTO, n.d.). When considering residential streets there is limited width so shared lane routes supported with managing speed and navigation help provide calmer feeder routes into higher-comfort facilities. All of this in consideration results in a connected hierarchy where collector streets serve as protected barriers, commercial corridors providing protective buffers, and residential with lower-stress routes. This design aligns with the Town of Frisco's concept of "high comfort" infrastructure as documented in their Trails Master Plan, prioritizing facility plans to reduce user stress and improve accessibility alongside current physical constraints (Town of Frisco, n.d.).

Network Connectivity and Mode Shift

When looking beyond individual infrastructure, network connectivity is crucial to support cycling mode shift. Fragmented networks discourage cycling, even with high quality individual segments (Dill & Carr, 2003). Research shows that connected bicycle networks highly increase transportation cycling with improved access to certain destinations such as workplaces, schools, and commercial areas (Buehler & Dill, 2016). Continuous infrastructure allows cycling to function as a viable and preferred transportation mode rather than simply a recreational activity.

A relevant case study is The Virginia Capital Trails– providing a practical example of the importance of connectivity. This 52 mile (fully separated path) works to connect multiple communities supporting commute, tourism, and routine travel. Its success is attributed to continuous design, safe and secure crossings, tourism, and consistent navigation (Virginia Capital Trail Foundation). Similarly, we can look at another case study example in Victoria, British Columbia– where the city has implemented a network of protected bike lanes that use

quick-build material, connecting a “skeleton network” of improved safety and accessibility (Streetfilms, 2020). These examples show the importance of bridging infrastructure gaps to support shift mode.

Quick-Build Infrastructure and Rapid Implementation

When looking at cost-effective and flexible approaches to improve cycling, quick-build infrastructure supports these efforts. These projects utilize temporary materials such as paint, bollards, and signage to quickly improve and evaluate effectiveness (NACTO, n.d.). Quick-build projects permit communities to:

- Improve safety rapidly
- Test different infrastructure designs
- Adapt methods based on community feedback
- Build based on public support

Research has shown that quick-build infrastructure increases cycling participation while encouraging safety. For small communities such as Frisco, where infrastructure investment balances cost, community support, and overall effectiveness.

Winter Cycling and Infrastructure Maintenance

More often than not winter conditions have been perceived as barriers to cycling– however, research shows that proper infrastructure and maintenance can help support cycling year-round. Chapman & Larsson (2021) finds that the quality infrastructure and maintenance highly influences cycling participation during the winter. For instance a case study example is the city of Oulu, Finland– a wonderful model. Despite the harsh wintry conditions, Oulu maintains cycling mode shares of around 12% due to constant snow conditions paired with proper infrastructure maintenance (City of Oulu 2020). For Frisco, winter maintenance is a critical factor to consider and with proper maintenance and design- it can be achieved and thrive.

Safety Frameworks and Vision Zero

Safety proves to be crucial when planning infrastructure. For reference, a relevant model is Richmond, Virginia's Vision Zero initiatives to help eliminate traffic fatalities through different infrastructure design approaches and policy interventions. The Vision Zero program helps to identify high-injury corridors and consistently improve safety conditions such as protected bike lanes and safer crossings for cyclists (City of Richmond, n.d.).

Vision Zero implements a Safe Systems approach working to recognize the fact that infrastructure design must consider human error and efforts for continuous improvements. Frisco’s Trails Master Plan aligns with Vision Zero principles in prioritizing safety and helping to reduce user conflicts and error (Town of Frisco, n.d.).

E-Bikes and Future Mobility Readiness

As electric bikes are expanding and becoming more popular amongst cyclists, this is majorly in correlation with the reduction of physical barriers such as terrain and distance (MacArthur, Dill, & Person, 2018). Research consistently demonstrates that as e-bike usage increases so does the expansion of participation amidst diverse populations– such as elders and people who would not typically participate in cycling (Fishman & Cherry, 2016). Infrastructure readiness like protected bike lanes and connected networks are essential in order to support e-bike adoption. Preparing infrastructure positions Frisco in real time to investing for future mobility and accessibility.

Active Transportation and Economic Resilience

Cycling infrastructure supports long-term economic development alongside tourism. Pröbstl-Haider et al. (2018) has found that cycling infrastructure improves tourism sustainability and visitors' experience when visiting– noting the complexity of the market for mountain and other forms of cycle tourism. This study also suggests a pressing need and demand for more tourist and cycle supportive infrastructure, not necessarily in the form of more trails. This has been seen in a similar Mountain community: Gunnison Valley where emphasized transportation infrastructures have proven essential for economic resilience and quality of life. With that, Frisco's Trails Masters Plan positions cycling infrastructure as crucial to community sustainability and participation (Town of Frisco, n.d.).

Professional Guidance and Case Study Applications

In addition to peer-reviewed research– professional infrastructure organizations and case samples further model the effectiveness of cycling infrastructure investments specific to small mountain communities such as Frisco. The Federal Highway Administration focuses on the fact that small towns are capable of achieving real results as far as an uptake in cycling participation through cost-effective models such as protected bike lanes, traffic calming and feeding, and quick-build infrastructure– to further improve connectivity and safety without a full-blow road reconstruction (Federal High Administration, 2016). When looking towards economic resilience– cycling infrastructure positively supports financial means by increasing local spending, tourism attraction, and enhancing community livability and participation– resulting in a valuable investment for mountain towns like Frisco who have a certain reliance on visitor capital gain (PeopleForBikes, n.d.).

That being said, the most connected networks of protected bicycle infrastructure have shown to encourage cycling as a transportation option while expanding access as a safe mobility option and eventually leading residents to choose cycling as a core transportation dependence. This then becomes a main component of sustainable city planning when it comes to transportation reliability and preference by residents and visitors (Institute for Transportation and Development Policy, 2021).

These models are further supported by real world examples such as in Finland where increased ridership through consistently maintained infrastructure and facilities, especially during harsh winter conditions, enables year-round cycling when proper planning is put into place; relevant for the current climate of Frisco (BicycleDutch, 2019). Together, these professional models demonstrate the importance and success of protected, planned, connected, and properly maintained bicycle infrastructure that is relevant to Frsico as a means of increasing cycling participation, strengthening economic liveliness, and long term supported sustainability.

Key Best Practices for Frisco

The literature review identifies the following key best practices relevant to Frisco:

1. Protected and high comfort infrastructure as a priority
2. Improving network connectivity
3. Implementing quick-build infrastructure
4. Winter cycling infrastructure and maintenance efforts established
5. Applying safety-focused planning frameworks
6. Prepared infrastructure for e-bike adoption
7. All strategies to increase cycle rider participation and supportive sustainable transportation systems

Conclusion

Research shows consistently that bicycle infrastructure plays a critical role in supporting transportation sustainability, resilience economically, and community participation and mobility. With protected and high-comfort facilities there are improved benefits as far as physical and perceived safety, which work to increase cycling participation across diverse populations including women, elders, and less experienced riders. These findings work closely alongside the Town of Frisco's Trails and Pathways Master Plan, prioritizing safe, accessible, and connected infrastructure.

Quick-build infrastructure offers a realistic and cost-effective opportunity for Frisco to quickly improve cycling conditions while giving flexibility to adapt designs based on the community's needs and interests. With an established, connected hierarchy where protected collector streets support as primary corridors, commercial streets provide buffered connections, and residential streets as low stress routes– there are viable transportation options to view cycling as a realistic mode of transportation rather than simply a means of recreation. While also considering that winter maintenance also plays a vital role to ensure year-round usability as seen in similar mountain communities.

Investing in high comfort infrastructure can help position Frisco to support further e-bike usage, improve access to jobs and services, and support tourism and overall quality of life. Overall,

prioritizing connectivity, safety, and accessibility will help support and strengthen Frisco to have multimodal transportation systems and long term sustainability goals.