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Bicycle End-of-Trip Facilities

A guide for Canadian municipalities and employers

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About this Guide

Is this guide for you?

This guide is primarily addressed to municipal agencies responsible for promoting bicycle use and providing bicycle facilities. The types of municipal agencies that are likely to find the content of this guide useful include transportation planning departments, public parking authorities, municipal and regional transit authorities, and travel demand management agencies (TMAs).

This guide is also of direct interest to employers of all sizes who may wish to provide bicycle parking and related facilities for their employees and clients. Other audiences that will find this guide useful include developers and owners of commercial as well as multi-family residential properties, who are interested in providing bicycle parking and related facilities.

Parking or facilities management at universities and colleges will also find this guide useful when implementing bicycle parking facilities on their campuses for students, faculty, and staff. Educational institutions should be especially interested considering the high rates of cycling amongst students especially at centrally located schools.

NGOs, especially those related to sustainability or bicycle advocacy, may be contracted by different organizations to plan and aid with the implementation of bicycle parking facilities will also be interested in this guide. Allégo, who are described in Section 6.3, are a good example of an NGO working with a client to build a bicycle parking facility.

Why use this guide?

This guide is intended to help municipalities create appropriate and attractive bicycle parking and related facilities that will encourage bicycle use. This guide can help municipal authorities determine where, how much, and what type of bicycle parking and related facilities to provide, and how to best design them. The guide will also help municipalities create incentives and regulations that will encourage the provision of bicycle parking and related facilities in the private realm.

For employers, this guide should be a useful resource for designing attractive long-term bicycle parking facilities that will encourage employees to commute by bicycle. It could also be useful for designing accessible short-term bicycle parking facilities that will attract cyclist clients.

What's inside?

Before entering the main content of this guide, the Glossary explaining the technical terminology that is used throughout this guide is provided.

Chapter 1 introduces the basic types and provides an overview of the key reasons for developing bicycle end-of-trip facilities. This chapter should be of interest to all users of this guide.

Chapter 2 provides general directives on where demand for bicycle end-of-trip facilities is likely to exist and proposes a variety of tools and methods for assessing demand. This chapter is mostly of interest to municipalities and employers.

Chapter 3 outlines the principal design considerations for bicycle end-of-trip facilities, covering topics such as exact location, physical dimensions, and layout. This chapter should be of interest to all users of this guide.

Chapter 4 outlines the costs related to building and operating different types of bicycle end-of-trip facilities. This chapter should be of interest to all users of this guide.

Chapter 5 proposes several types of incentives and regulatory mechanisms that municipalities can use to encourage employers, developers, and property owners to provide bicycle end-of-trip facilities. This chapter is primarily of interest to municipalities.

Chapter 6 contains five case studies that illustrate good practices in the provision of bicycle end-of-trip facilities. As the case studies focus on the provision of bicycle parking in the public realm, this chapter is primarily of interest to municipalities.

The Sources section at the end of this guide provides a list of all documents that were consulted in its preparation, a list of web resources with useful information for planning and designing bicycle end-of-trip facilities, and a list of major vendors providing bicycle parking and related equipment.

Glossary

bicycle end-of-trip facilities: all infrastructure related to bicycle parking. Includes bicycle supports (stands and racks) bicycle parking area enclosures (sheds, canopies, and cages). Also includes complementary infrastructure such as lockers, change rooms, showers and so on.

short-term bicycle parking: simple outdoor stands or racks with no weather protection and limited security measures. Also called *Class II* or *Class B* bicycle parking.

long-term bicycle parking: partially- or fully-enclosed or indoor bicycle parking offering weather protection and increased protection against vandalism and theft. Often includes complementary infrastructure such as equipment lockers, change rooms, and showers. Also called *Class I* or *Class A* bicycle parking.

bicycle station: high capacity long-term bicycle parking facility open to the general public. Usually located in city centres near major public transit hubs, educational institutions, and dense employment areas. Often includes complementary infrastructure such as equipment lockers, change rooms, showers, bicycle part and accessory vending machines or kiosks, air pumps, bicycle maintenance service, maps and information, and food and beverage vending machines or kiosks.

bicycle-transit trip chaining: the use of bicycle for access to or from public transit.

bicycle stand: a single vertical unit which can support either one or two-bicycles.

bicycle rack: a unit with multiple vertical elements to support several bicycles. A bicycle rack can be created by mounting several bicycle stands on a metal rail or platform.

bicycle shed: a roof or partial enclosure over a bicycle parking area. Sheds can be freestanding structures or can be awnings or berths attached to a building.

bicycle cage: a fenced or walled full enclosure around a bicycle parking area. A key combination code is usually required to access the cage.

bicycle locker: a fully enclosed container large enough to fit a standard bicycle. Can also be used to store other belongings, such as helmets and bags.

1 Introduction

1.1 What are bicycle end-of-trip facilities?

The term *bicycle end-of-trip facilities* refers to parking and complementary infrastructure for bicycles. Bicycle parking infrastructure includes: stands or racks that support bicycles; and shelters or enclosures that protect parked bicycles from vandalism, theft, as well as the elements. Complementary infrastructure includes: lockers for stowing helmets, bicycle clothing, and other personal belongings; change rooms and showers; air pumps; and sometimes even bicycle parts and maintenance shops.

1.2 Types of End-of-Trip Facilities

This guide divides bicycle end-of-trip facilities into two broad categories: (1) short-term bicycle parking and (2) long-term bicycle parking.

1.2.1 Short-Term Bicycle Parking

Short-term bicycle parking, also called *Class II* or *Class B* bicycle parking, consists of simple outdoor stands or racks (Litman, 2006; Vancouver, 2001). It usually has the following features:

- placed in a highly visible location outdoors
- low level of service
  - no weather protection
  - limited protection against vandalism and theft
  - limited complementary infrastructure
- for use by the general public
- free of charge

1.2.2 Long-Term Bicycle Parking

Long-term bicycle parking, also called *Class I* or *Class A* bicycle parking, consists of bicycle stands or racks in an enclosure (partial or complete) or lockers that house individual bicycles (Litman, 2006; Vancouver, 2001). It usually has the following features:

- can be placed indoors or outdoors, not necessarily in a highly visible location
- higher level of service
  - higher level of weather protection
  - higher level of vandalism and theft protection

    - can include complementary infrastructure
- for use by designated users or paying users
- fees for use are common

1.3 Who provides bicycle end-of-trip facilities?

As with automobile parking, bicycle parking is provided both on public and private land. The responsibility for the provision of both automobile and bicycle parking is therefore shared between municipalities and landowners.

1.3.1 Public Facilities

On public land, short-term bicycle parking facilities are distributed along streets and in public spaces, particularly in shopping areas. Public long-term bicycle parking facilities are typically located near major trip generators, especially commuter trip generators. These include public transit nodes, educational institutions, and dense employment areas. Larger public bicycle parking facilities, or *bicycle stations*, can include some complementary infrastructure such as bathrooms, lockers, air pumps, and occasionally maintenance shops. However, showers and change rooms are typically not provided at end-of-trip facilities on public land.

1.3.2 Private Facilities

On private land, both short-term and long-term bicycle parking is commonly provided. The capacities of short- and long-term bicycle parking and the selection of complementary infrastructure depend on the nature of the land use on a given property. For example, at commercial and institutional properties, short-term outdoor bicycle parking is provided outdoors for clients or visitors, while long-term bicycle parking is provided indoors or in a sheltered area for the employees. In this case, complementary infrastructure such as lockers, change rooms, and showers can accompany the long-term parking infrastructure. As another example, at residential and especially high-rise properties, some short-term bicycle parking is provided outdoors for visitors and long-term bicycle parking is provided indoors for residents. In this case, however, there is no need for complementary infrastructure as residents can store their belongings, change, shower, and so on in their own apartments.

1.4 Why should municipalities develop bicycle end-of-trip facilities?

The primary reason for developing bicycle end-of-trip facilities is that they encourage the use of bicycles as a mode of transportation. They do so by making bicycle use for utilitarian purposes more convenient and attractive. When bicycle end-of-trip facilities are provided at public transit hubs, they can help foster bicycle-transit trip chaining, simultaneously encouraging bicycle use and transit use.

All measures that encourage bicycle use can be said to increase transportation sustainability. The benefits of encouraging bicycle use as compared to using automobiles or public transit include:

- greater speed and flexibility on short distances (generally, up to 5 km)
- health benefits for users, particularly reduced risk of obesity and improved cardiovascular health
- environmental benefits, particularly reduced energy use and fossil fuel emissions
- lower cost for user
- limited capital and operating costs for infrastructure and low impacts on existing road infrastructure.

Beyond making bicycle use more convenient and attractive, the provision of end-of-trip facilities can help increase public acceptance of the bicycle as a mode of transportation. A significant share of Canadians probably still see cycling primarily as a form of recreation and do not consider it as one of their transportation options. Only 1.2% of Canadians commute to work by bicycle (Statistics Canada, 2009). By providing highly visible, high quality end-of-trip facilities for bicycles, a municipality can convey the message that cycling is a legitimate and respected form of transportation. This has the potential to inspire more members of the public to consider using the bicycle as a realistic transportation option and to instil greater respect for cyclists, especially among motorists.

Finally, visible, high quality bicycle end-of-trip facilities can also have a positive impact on the image of the municipality. They can help project a commitment to environmentally responsible practices and a progressive outlook.

1.4.1 Why develop short-term bicycle parking?

There are two primary reasons for developing on-street, short-term bicycle parking, especially in commercial areas. These include:

- encourage bicycle use for utilitarian purposes, especially shopping
- make bicycle parking more orderly
    - prevent bicycles from being locked to and damaging traffic signs, fences, trees, and so on
    - prevent bicycles from obstructing pedestrian and vehicular traffic

1.4.2 Why develop long-term bicycle parking?

The main reason for developing long-term bicycle parking is to encourage direct commuting by bicycle or commuting using a combination of bicycle and transit. As commuters need to safely stow their bicycles for relatively long periods of time, the risk of vandalism and theft can be an important discouraging factor.[1] Long-term bicycle parking facilities that afford a relatively high level of security mitigate fears of vandalism and theft and encourage bicycle commuting, both direct and chained.

In terms of bicycle-transit trip chaining, long-term bicycle parking facilities at transit stations can both encourage bicycle use for travel between home and the transit system as well as for travel between transit system and the workplace or school. In the latter case, a bicycle station at a transit hub could allow a transit commuter to stow a bicycle (in some cases, it could be his/her second bicycle) overnight and use it to travel between that transit hub and work or school. This is a relatively popular practice in Europe, particularly in the Netherlands where over 10% of trips from transit to a destination other than home are made by bicycle (Rietveld, 2000; Keijer & Ritveldm, 2000).

1.5 Why should employers develop bicycle end-of-trip facilities?

There are a number of reasons for employers to invest in bicycle parking and complementary facilities. These include:

- increasing overall parking capacity at little cost
- gaining a competitive advantage by attracting bicycling customers
- attracting and retaining healthy and environmentally conscious employees
- reducing clutter, hazards for pedestrians and automobiles, and tree damage from unplanned bicycle parking
- mitigating the environmental impacts related to employees and customers travelling by automobile
- projecting a positive and environmentally conscious image

[1] In 2007, around 44,000 bicycle thefts were officially reported to police. As a large share of bicycle thefts are unreported, the actual number of is likely to be much higher – as high as 100,000 bicycles stolen nationwide per year (CBC News, 2008).

2 Assessing Demand

There is no well-established method for assessing demand for bicycle end-of-trip facilities for a given site. Relative demand at the given site is likely to depend on a number of factors, such as land use, the presence of designated bicycle routes and the nature of the road network as well as the topography of the surrounding area. The first part of this chapter explains how these factors affect demand for different types of end-of-trip facilities.

An understanding of the influencing factors may not be sufficient to estimate demand for a given site. Local data from a variety sources can be used to identify locations at which there is demand for bicycle end-of-trip facilities. The second part of this chapter describes a number of sources of data that can be useful assessing demand for different types of end-of-trip facilities.

2.1 Factors Influencing Demand

Demand for bicycle parking is likely to be influenced by a number of factors. The following sections focus on four key factors that are known to influence levels of bicycle use and demand for bicycle end-of-trip facilities. These factors include:

- land use
- bicycle routes and the road environment
- topography.

2.1.1 Land Use

Land use is a key a factor influencing the demand for bicycle end-of-trip facilities. Levels of demand for short-term parking, long-term parking, and complementary infrastructure are likely to vary considerably across land uses. This is reflected in how municipalities specify requirements for bicycle parking on private properties. The requirements are typically written into zoning by-laws, with different amounts of short-term (*Class II* or *Class B*) and long-term (*Class I* or *Class A*) required for each land use category. Municipal bicycle parking requirements are discussed and examples are provided in Section 5.2.

The following subsections provide general remarks about the demand for short-term, long-term, and complementary infrastructure across land uses. Table 1 summarizes the relative demand for end-of-trip facilities at common land use categories.

Short-Term Parking

Demand for short-term bicycle parking is likely to exist at land uses that generate a relatively large number of trips but where people spend relatively little time. Land uses fitting this description include commercial areas with high levels of retail and service activity, as well as certain institutional areas such libraries, schools, and hospitals.

Long-Term Parking

Demand for long-term parking is likely to exist at any land use that features employment. Employees who commute by bicycle require secure bicycle parking for the duration of the workday. As all commercial, industrial, and institutional land uses feature employment, they are all likely to create demand for long-term bicycle parking; the more employment in a given area, the greater the potential demand.

Demand for long-term bicycle parking can also exist in some residential areas. In particular, demand is likely to exist at multi-family residential buildings, where storage of bicycles within the dwelling units might not be possible due to space restrictions or difficulty in transporting bicycles to dwellings above grade. In this case, secure long-term bicycle parking that is easily accessible from grade is likely to be in demand.

Transit hubs are another land use where demand for long-term bicycle parking is likely to exist. Commuters who travel between home and a transit hub by bicycle are likely to require secure bicycle parking for the duration of the workday. Commuters who travel between a transit hub and work may wish to have secure overnight bicycle parking.

Complementary Infrastructure

Complementary infrastructure, particularly showers and change rooms, are likely to be in demand at land uses that feature employment. These include commercial, industrial, and institutional land uses. The demand for showers and change rooms is likely to be related to the demand for long-term bicycle parking at these land uses; the more employment in a given area, the more demand for both long-term parking and the more demand for showers and change rooms.

Table 1 – Demand relative to floor area for end-of-trip facilities at different land uses

Land Use Category	Short-term or Class II Spaces	Long-term or Class I Spaces	Change Rooms and Showers
Residential			
Single Family or Duplex	**NONE**	**NONE**	**NONE**
Multi-Family	Ⓟ 🚲 for visitors and residents	Ⓟ 🚲 🚲 for residents	**NONE**
Commercial			
Downtown Office	**NONE**	Ⓟ 🚲 🚲 for employees	**YES** for employees
Non-downtown Office	**NONE**	Ⓟ 🚲 for employees	**YES** for employees
Individual Retail Establishment	Ⓟ 🚲 🚲 for clients	Ⓟ 🚲 for employees	**YES** for employees
Local Shopping Mall	Ⓟ 🚲 for clients	Ⓟ 🚲 for clients and employees	**YES** for employees
Regional or Neighbourhood Shopping Centre	Ⓟ 🚲 for clients	Ⓟ 🚲 for employees	**YES** for employees
Industrial			
All Sites	**NONE**	Ⓟ 🚲 for employees	**YES** for employees
Institutional			
Elementary or Secondary School	Ⓟ 🚲 🚲 for students	Ⓟ 🚲 for employees	**YES** for employees
College or University	Ⓟ 🚲 🚲 🚲 for students	Ⓟ 🚲 🚲 for students and employees	**YES** for students and employees
Hospital	Ⓟ 🚲 for visitors	Ⓟ 🚲 for patients and employees	**YES** for employees
Cultural and Recreational			
All Types	Ⓟ 🚲 for patrons	Ⓟ 🚲 for patrons and employees	**YES** for employees
Transit			
LRT and subway stations	Ⓟ 🚲 for commuters	Ⓟ 🚲 🚲 for commuters	**NONE**

Key:
Ⓟ 🚲 low demand
Ⓟ 🚲 🚲 increased demand
Ⓟ 🚲 🚲 🚲 high demand

Source: based on Littman et al., 1999

2.1.2 Bicycle Routes and the Road Environment

Relatively high levels of bicycle use are likely to occur in areas near a designated bicycle route or in areas in which the road environment is bicycle friendly. It follows that demand for bicycle parking, both short- and long-term is likely to be elevated in the catchment area of a bicycle route or within an area with a bicycle friendly road environment.

Based on research that has investigated cyclists' perceptions of road environments (Landis, 1998) the following factors are expected to have a positive impact on bicycle use:

- small number of traffic lanes
- low traffic volume
- low share of heavy vehicles (trucks and buses) in the traffic stream
- low traffic speeds
- wide curb lanes or paved shoulders in the absence of curbs

Roads that have at least some of the above features are likely to attract higher levels of bicycle traffic. For example, the same grocery store on a two-lane local street with a speed limit of 40 km/h is likely to attract more shoppers on bicycles than a four-lane arterial with a speed limit of 60 km/h.

2.1.3 Topography

Cyclists generally dislike going up inclines of more than 4% and avoid inclines greater than 8% (IDAE, 2007). In an area in which streets mostly have slopes under 4%, topography should not affect levels of bicycle use and demand for bicycle parking. In an area where many streets are sloped between 4% and 8%, bicycle use and demand for bicycle parking would be expected to decline with increasing slope. In addition, demand for bicycle parking should also decrease as a function of elevation. Streets with 8% slopes are expected to have little or no bicycle traffic and therefore little if any demand for bicycle parking.

2.2 Evaluating Demand

2.2.1 Census

Nationwide data on bicycle use for commuting is collected every five years by Statistics Canada through the Census of Canada. The census provides data on where bicycle commuters live but not their location of work or school, which would allow planners to estimate demand for bicycle parking at precise locations. Nevertheless, the available data can still be useful. Areas where a relatively large number of bicycle commuters live are likely to have high overall levels of bicycle use. Where there are high levels of bicycle use, there is increased demand for bicycle parking. Hence, census data can be useful for identifying parts of the community where bicycle use and demand for bicycle parking are elevated.

2.2.2 Household Travel Surveys

Several metropolitan transportation authorities in Canada perform household travel surveys, also know as origin-destination studies, which collect data on bicycle use for commuting as well as other purposes. Household travel surveys are a potentially rich source of data for assessing demand for bicycle end-of-trip facilities because they usually record the origin and the destination, the time, and the purpose of all trips taken over the course of a day. Data on origins and destinations allow the identification of locations with the greatest demand for end-of-trip facilities. Data on trip times allows for a better understanding of the exact nature of the demand, as it reveals when people are at particular locations and how long they remain there. This is very useful for determining the required parking capacity and the type of bicycle parking required—i.e., sort-term or long-term. Data on trip purpose can help identify locations at which change rooms and showers are required—i.e. at locations where the purpose of trips is work-related, there is likely to be demand for change rooms and showers.

It should be noted that data from household travel surveys can be used to roughly estimate demand for end-of-trip facilities in relatively large geographic units—e.g., a neighbourhood, a section of downtown, or the vicinity of transit station. In particular, data from household travel surveys could be invaluable for identifying areas in which on-street bicycle parking should be improved or locations at which large public bicycle parking facilities—i.e., bicycle stations—could be provided. However, sampling rates of household surveys will generally not be sufficient to allow accurate estimates of demand for bicycle parking at a precise location.

2.2.3 Cyclist Surveys

A few municipalities in Canada have carried out surveys of cyclists in the recent past. These surveys were administered to cyclists intercepted while riding their bicycles, either while riding on designated bicycle routes (e.g., North Vancouver Joint Bicycle Advisory Committee, 2002) or while crossing a cordon line around a particular area of the municipality (e.g., City of Calgary, 2006). Such surveys have typically included questions about habits (origins and destinations of frequent trips, routes taken), about the use of and satisfaction with available cycling facilities (paths, parking), and solicited suggestions for future improvements to cycling facilities.

Unlike randomly selected telephone surveys, intercept surveys are relatively inexpensive to conduct. Specific questions about satisfaction with and improvement to bicycle end-of-trip facilities can be included, which can help identify locations at which there is demand for end-of-trip facilities. This type of survey could also be used to probe current cyclists' interest in and help identify locations for a public bicycle station (see Section 3.4 for more on bicycle stations).

A disadvantage of this type of survey is that data is collected only from people who are already cyclists. As a result, this type of survey might not necessarily provide data on improvements to end-of-trip facilities that would encourage non-cyclists to use bicycles.

2.2.4 Employer Surveys

An increasing number of Canadian municipalities have set up transportation management agencies (TMAs), whose mandates are usually to reduce commuting by single-occupancy vehicle (SOV). TMAs work directly with employers in the community to gather information about employees travel habits and to find alternatives to SOVs for commuting to work. It is not uncommon for TMAs and participating employers to jointly conduct a survey of employees travel habits and needs. This type of survey can be used as an opportunity for assessing potential demand for long-term bicycle parking and complementary facilities, such as change rooms and showers at the given workplace. If the survey is being conducted in a dense employment area, it could also be used to probe interest in a nearby public bicycle station.

2.2.5 Monitoring and Self-Reporting

In many cases, direct observation might be the best way to evaluate demand, particularly for bicycle parking. Areas known to have significant levels of bicycle traffic (based on data from Household Travel Surveys or from local traffic counts) could be regularly monitored in order to observe parked bicycles. Attention should be paid to locations where bicycles are habitually locked to objects other than those designated for bicycle parking, which would suggest insufficient bicycle parking infrastructure.

In addition to assigning human resources to monitor bicycle parking demand in high traffic areas, a community can also set up a self-reporting system to aid with monitoring. Such a system would allow citizens and property owners to report problems with bicycle parking. The system can also be used to solicit requests for additional bicycle parking facilities. The City of Toronto, for example, has set up a simple system through which businesses and property owners can submit a request for a post-and-ring bicycle stand to be installed near their business or property.

3 Design Considerations

This chapter outlines general design considerations for bicycle end-of-trip facilities, with a primary focus on parking infrastructure. The intention is to provide planners and designers with information to help them create attractive and functional bicycle parking facilities, with complementary infrastructure where appropriate.

The chapter has three main sections. The first section deals with general design considerations that apply to both short-term and long-term parking. The second deals with considerations for specific to short-term parking. The third and fourth sections deal with considerations on-site long-term parking—i.e. parking that belongs to a particular building or property. The fourth and last section deals with consideration for the design of bicycle stations—i.e. high capacity, long-term bicycle parking facilities. These are dealt with separately from on-site long-term parking as they entail a distinct set of design considerations.

3.1 General Considerations

The following sections discuss two design considerations that are applicable to all forms of bicycle parking—short-term and long-term, on- and off-site. The first provides an overview of suggested dimensions for bicycle parking areas, which are essentially the same for short- and long-term parking facilities. The second is the design of the infrastructure that supports bicycles—i.e., bicycle stands and racks—which can be used for both short- and long-term bicycle parking applications.

3.1.1 Dimensions and Site Planning

This section provides information that will help planners estimate the area required for bicycle parking facilities. Four different parking patterns with different footprints are presented, ranging from the least to the most space efficient. Generally speaking, the more space efficient patterns are less convenient and are best used for long-term parking application, where bicycle turnover is low. In the case of short-term parking, where bicycle turnover is high, it is preferable to sacrifice capacity (by spacing racks further apart) for ease of use.

Site Planning Basics

The basic dimensions of a bicycle are illustrated in Figure 1. Where bicycles are parked side-by-side in rows, the stands or racks that support the them must be sufficiently spaced to allow bicycles to be moved in and out of a parking berth without making contact with neighbouring bicycles. Each row of parked bicycles must be served by an aisle that is wide enough accommodate the length of a bicycle that is being moved in or out of a parking berth. The minimum required width is the same for an aisle serving a single row of bicycles and for an aisle straddled by two rows of parked bicycles.

Figure 1 - Basic bicycle dimensions

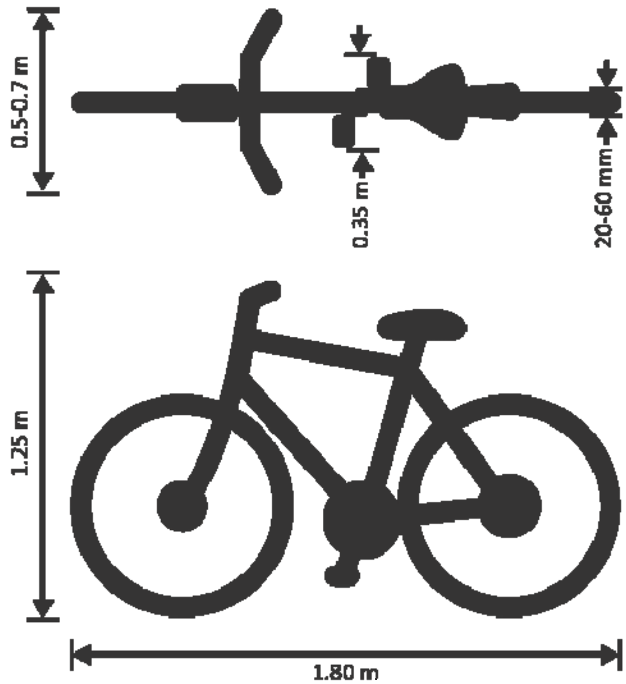

Illustration: Gris Orange Consultant Inc., adapted from Celis and Bølling-Ladegaard, 2008

Configuration 1: one-per-stand perpendicular

The most basic configuration is to have a row of bicycles supported by individual stands (Figure 2). The bicycles are positioned perpendicular to an aisle that is at least 1.75 metres wide, regardless of whether it serves one row or two straddling rows of bicycles. This width allows sufficient clearance for bicycles to be pulled in and out of their berths and allows two cyclists walking their bicycles to pass each other. The bicycle parking area should be 2.0 metres deep to allow for sufficient clearance from a wall or an adjacent row of parked bicycles. The optimal distance between each single-bicycle stand is 0.6 metres. It is possible to reduce the separation to 0.5 metres, but the stands must then allow the bicycles to be staggered slightly so that their handlebars do not overlap. However, as mentioned above, higher density configurations with stands closer together are not recommended for short-term parking applications. A bare minimum clearance of 0.4 metres is required between the first or last bicycle stand in the row and a wall or other barrier at the edge of the parking area; a minimum clearance of 1.0 metre is preferable.

Figure 2 - Basic dimensions for the one bicycle per stand perpendicular configuration

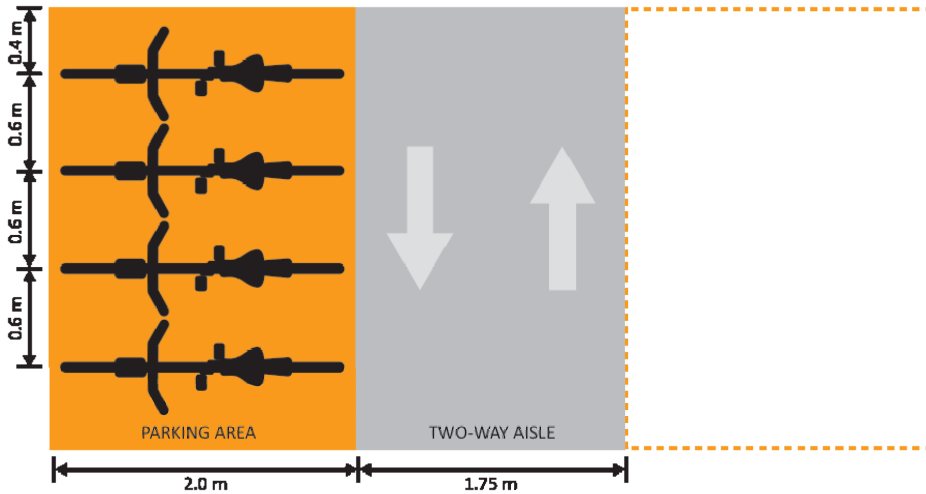

Illustration: Gris Orange Consultant Inc.

It is worth noting that the parking areas for two adjacent rows of bicycles in the one per stand perpendicular configuration can partially overlap (Figure 3). The racks supporting each of the two rows of bicycles can be staggered so that front wheels of bicycles in one row fit in between the front wheels of those in the row. As a result, the combined parking area for the two rows needs only to be 3.0 metres wide. An appropriate bicycle rack for staggering two rows of bicycles in this manner is shown in Figure 4.

Figure 3 - Two partially overlapping rows of perpendicular parked bicycles

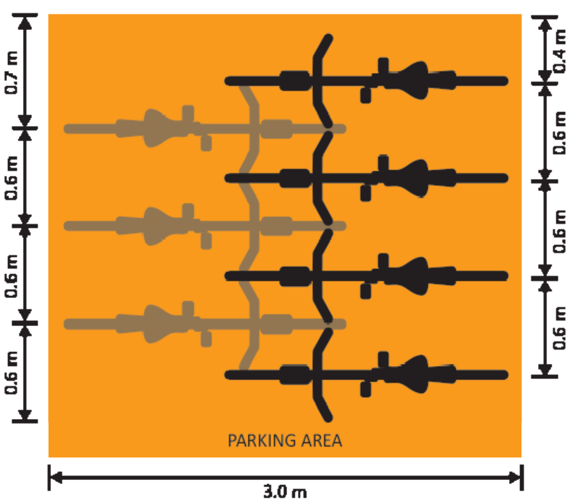

Illustration: Gris Orange Consultant Inc.

Figure 4 - A two-side *lightning bolt* type rack can hold two partially overlapping rows of bicycles

Photo: Creative Pipe Inc.

Configuration 2: two-per-stand perpendicular

Another common configuration is to have a row of stands supporting two bicycles each (Figure 5). The bicycles are positioned perpendicular to an aisle that is at least 1.75 metres wide, allowing sufficient clearance for bicycle to pull in and out of their berths and allowing two cyclists walking their bicycles to pass each other. The bicycle parking area should be 2.0 metres deep to allow for sufficient clearance from a wall or an adjacent row of parked bicycles. The minimum required distance between each single-bicycle stand is 0.75 metres. An absolute minimum clearance of 0.5 metres is required between the first or last bicycle stand in the row and a wall or other barrier at the edge of the parking area; a 1.0 metre clearance is preferable.

Figure 5 - Basic dimensions for the two bicycles per stand perpendicular configuration

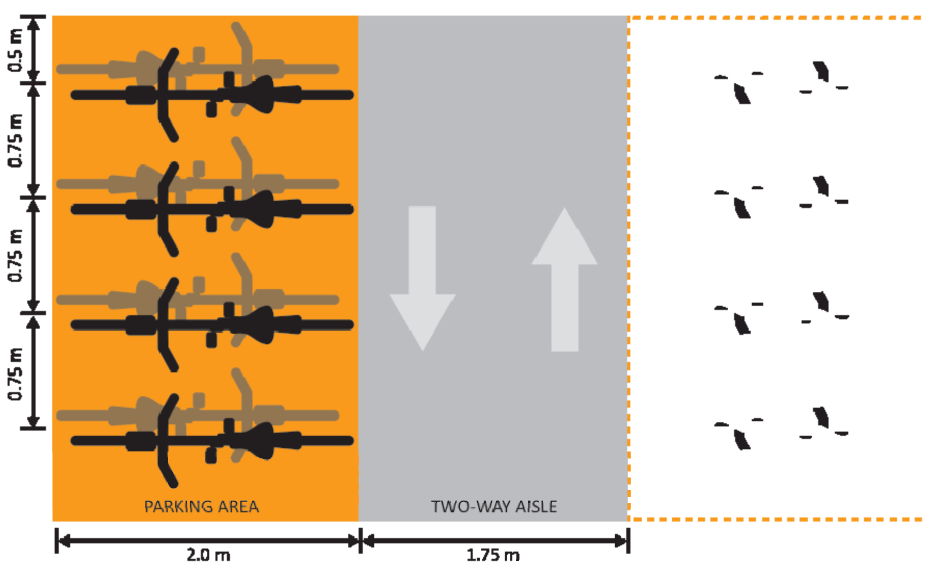

Illustration: Gris Orange Consultant Inc.

Configuration 3: one-per-stand angled

If space is at a premium, bicycles can be angled with respect to the aisle to reduce the depth of the parking area (Figure 6). By angling them at 45° with respect to the aisle, the depth of the parking area is reduced to 1.4 m. As the bicycle pull in and out of the aisle at an angle, it is possible to reduce the width of the aisle as well. With a 45° parking angle, a minimum aisle width of 1.0 metre is recommended. At that width, the aisle becomes one-way, as it is no longer wide enough for two cyclists walking their bicycles to pass each other. Single-bicycle stands should be placed a minimum of 0.5 metres apart to limit contact between handlebars as bicycles are being pulled in and out of the berths. Stands should be placed so that there is at least 0.3 metres between the front or rear end of a typical bicycle and the edge of the bicycle parking area. An appropriate bicycle rack for 45° parking is shown in Figure 14.

Figure 6 - Basic dimensions for the one bicycle per stand 45° angled configuration

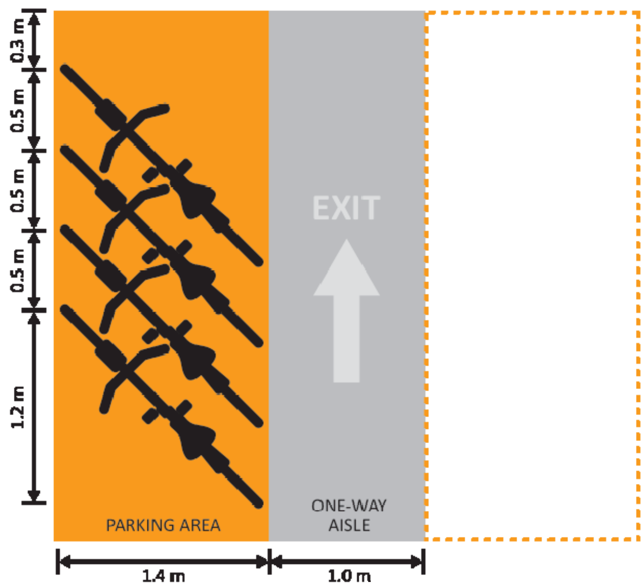

Illustration: Gris Orange Consultant Inc.

Figure 7 - Bicycle stands for angled parking

Photo: Creative Pipe Inc.

Configuration 4: wall-mounted

An even more space saving configuration involves suspending bicycles on wall-mounted hangers (Figure 8). This allows the footprint of the parked bicycles to be only 1.25 metres deep. To limit contact with neighbouring bicycles while mounting and dismounting a bicycle from the hanger, hangers should be placed 0.6 metres apart. It is possible to reduce the separation of the hangers to 0.5 metres apart by staggering the height at which they are mounted. This prevents the handlebars of neighbouring bicycle from overlapping. It should be noted that the wall to which the hangers are mounted must be at least 2.0 metres high. Although this configuration is very space efficient, it has a significant disadvantage: bicycles must be lifted to be mounted on the wall hangers. This may prevent some people from using this type of bicycle parking.

Figure 8 - Basic dimensions for the wall hanging configuration

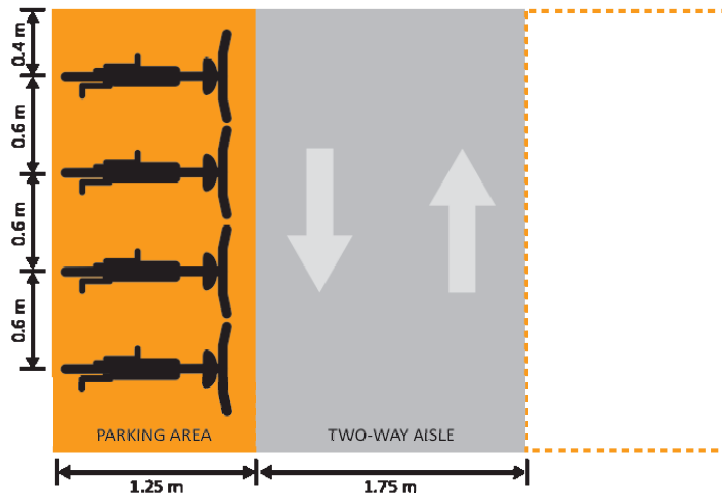

Illustration: Gris Orange Consultant Inc.

Figure 9 - Wall-mounted bicycle hangers are staggered to prevent handlebar contact between neighbouring bicycles

Photo: Bicycle Victoria

3.1.2 Parking Infrastructure

This section provides an overview of common design for bicycle parking supports, including individual bicycle stands that support one or two bicycles and racks that support multiple bicycles. All of these common designs can be used for short- and long-term bicycle parking application. A few innovative designs, which involve adapting existing street furniture to serve as bicycle supports, are also mentioned. However, these are mostly suitable for on-street, short-term parking applications.

Common Stand Designs

A bicycle *stand* is defined here as a single vertical unit which can support either one or two-bicycles. Each bicycle stand must be directly anchored to the ground. Alternatively, stands can be mounted onto a metal beam (see Figure 12 and Figure 14) or a platform to reduce the number of anchor points and simplify installation.

Good bicycle stand designs are those to which a bicycle's frame can be attached using a 'U' shaped locked. The *inverted 'U'* (Figure 10 and Figure 11), the *swerve* (Figure 12), and the post-and-ring (Figure 13) are common, simple geometries for bicycles that fulfil this requirement. Stands of all three types can support two bicycles each (one on either side of the stand). While all three designs are considered functionally equivalent, the post-and-ring type design has a slight advantage: it has one anchor point rather than two, which simplifies installation.

Figure 10 - Wide inverted 'U' stand

Illustration: Gris Orange Consultant Inc.

Photo: Christopher DeWolf

Figure 11 - Narrow inverted 'U' stand

Illustration: Gris Orange Consultant Inc.

Photo: AllWaysNY.com

Figure 12 - Swerve stand

Illustration: Gris Orange Consultant Inc.

Photo: Matthew Cole

Figure 13 - Post-and-ring stand

Illustration: Gris Orange Consultant Inc.

Photo: rubiking.wordpress.com

Another common bicycle stand design that allows the use of 'U'shaped lock is the *lightning bolt* (Figure 14). Unlike the previous three designs, it is intended to support only one bicycle. A small rail at the base of the lightning bolt holds the front wheel of a bicycle in place, keeping the bicycle aligned along the desired axis. This feature makes lightning bolt stands excellent for application in which bicycles are parked in relatively dense perpendicular rows (Figure 2) or angled rows (Figure 6 and Figure 7).

Figure 14 - Lightning bolt stand

Illustration: Gris Orange Consultant Inc.

Photo: Creative Pipe Inc.

Common Rack Designs

A bicycle *rack* is a unit with multiple vertical elements to support several bicycles. When a larger number of bicycle parking spaces are required, bicycle racks have the advantage of having fewer anchor points than individual bicycle stands. If a rack is heavy enough, it might not be necessary to anchor it at all. As noted earlier, a bicycle rack can be created by mounting individual bicycle stands on a metal rail or platform. However, not all racks are formed this way. The racks presented in this section are those which have vertical elements that do not function as bicycle stands on their own but are rather an integral part of the rack.

As with individual bicycle stands, good bicycle rack designs are those that bicycles' frames can be attached to using a 'U' shaped lock. Another critical design consideration is the spacing of the vertical element of the rack. To avoid conflict between neighbouring bicycles, the vertical elements should be at least 60 cm apart (see Figure 2).

A very popular bicycle rack design that fulfils the U-lock criterion is the *campus rack* (Figure 15). It consists of thick metal pipe from which quadrilateral round or quadrilateral hoops are suspended. To function adequately, the hoops must project outward sufficiently to meet the bicycle's frame.

Figure 15 - Campus rack

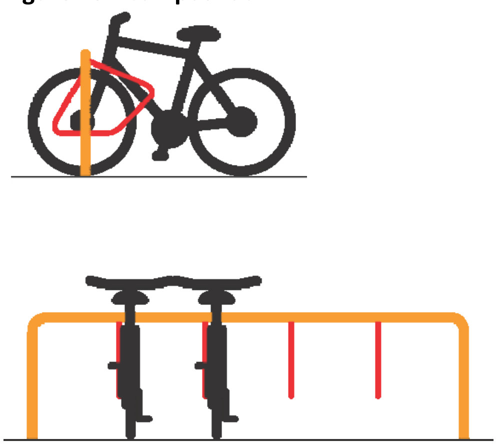

Illustration: Gris Orange Consultant Inc.

Photo: Dero Bike Racks

Another popular type of bicycle rack that is considered acceptable is the *wave rack* (Figure 16). Although they fulfil the U-lock criterion, the Association of Pedestrian and Bicycle Professionals (APBP, 2002) recommends against using them, especially shorter ones with only two peaks. The reason is that there is a tendency for cyclist to use them like inverted 'U' bicycle stands, locking bicycles in parallel instead of perpendicular to the width of the rack. Designs with perpendicular projections, such as the *campus* design described above, avoids this problem.

Figure 16 - Wave rack

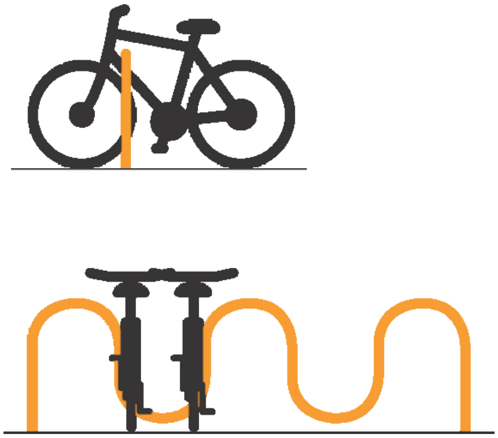

Illustration: Gris Orange Consultant Inc. Photo: Brad Aron/Streetsblog.org

Bicycle rack designs that should be avoided are all those which only hold a bicycle wheel but do not provide the frame with support. An example is the so-called *comb rack* design (Figure 17). Except at the two ends of the rack, bicycles must be placed parallel to the rack in order to be properly secured through the frame with a 'U' shaped lock, as these types of locks are the most secure against theft. It is important that the frame, rather than just the wheel, can be locked to the rack as theft often occurs when the locked wheel is removed and the rest of the bicycle is taken.

Figure 17 - Comb racks

Photo: Mitch Harper/Fort Wayne Observed

Innovative Designs

An innovative approach to creating bicycle parking at little cost is to modify existing street furniture so that it can act as a bicycle stand. One type of street furniture that can be used for locking bicycles is parking meters. Parking meters are widely distributed across commercial districts, where there tends to be high demand for short-term bicycle parking. Even without modification, most parking meter posts are suitable for locking bicycles with a 'U' shaped lock, as the heads of the posts are usually too wide to fit through the lock. However, without modification, parking meter posts are unsuitable for locking bicycles with chain and cable locks; if the chain or cable is not taught enough, the bicycle can be lifted right off the post. A simple modification that makes a parking meter suitable for all types of locks is to add a hoop roughly halfway up the post. One community that has widely applied this approach is the City of Montreal. The municipal parking authority, Stationnement de Montréal, has added horizontal hoops to thousands of parking meter posts across the city (Figure 18). The hoops have been added only to those posts where parked bicycles would not block pedestrian traffic and building entrances.

Figure 18 - Bicycle locking hoop added to a parking meter post in Montreal, QC

Photo: Misha Warbanski

Many other types of street furniture, such as lampposts and signposts, can be similarly modified to accommodate and also visually legitimize bicycle parking. There are products available on the market for this purpose, an example of which is the *Cyclehoop*, which coverts any vertical post to a post-and-ring bicycle stand (Figure 19). This would be a cheaper option as it is a ready-made design and can easily be affixed to existing posts without modification.

Figure 19 - The *Cyclehoop* is a device for converting street furniture to bicycle parking

Photos: Cyclehoop Ltd.

3.2 Short-Term Parking Facilities

3.2.1 Location

Short-term bicycle parking facilities should generally be placed in a visible location, as close as possible to a building entrance. The Association of Pedestrian and Bicycle Professionals recommends that bicycle parking be located along a principal line of approach to a building and that it be no more than a 30 second walk or 35 metres from the principal building entrance (APBP, 2002). A Danish guide on bicycle parking design recommends that bicycle stands be even closer, at 5 to 10 metres from the entrance (Celis and Bølling-Ladegaard, 2008).

On streets where buildings are set close to the sidewalk, short-term bicycle stands should be placed within the public right-of-way. To accommodate a bicycle stand while leaving enough room for pedestrians, a sidewalk must be at least 3.0 metres wide (City of Chicago, 2002). If the sidewalk is narrower than 3.0 metres or if sidewalk space is limited due the presence of trees or other street furniture, bicycle parking can be created in the curbside lane, replacing an automobile parallel parking space. The City of Montreal, for example, converts selected parallel parking spaces to bicycle parking spaces for the duration of the cycling season, or early April until late November (Figure 20). One standard car parking space can accommodate between 10 to 12 parked bicycles (PBIC, undated).

Figure 20 - Parallel parking spaces converted to bicycle parking in Montreal, QC

Photo: Christopher DeWolf

Where buildings are set far from the sidewalk, bicycle parking should be placed on private properties instead of in the public right-of-way. As mentioned above, short-term parking should be placed in a visible location near the primary building entrance. Some municipalities (e.g., City of Chicago, 2002) distribute bicycle parking guidelines to business, which include recommendation on where to locate short-term parking for customers.

3.2.2 Design

Short-term bicycle parking should prioritize convenience and accessibility over all other considerations. As mentioned in the section on parking area dimensions, it is recommended that bicycle stands (or the vertical elements on bicycle racks) be spaced relatively generously for short-term parking applications, to allow easy and rapid placement and removal of bicycles.

Short-term bicycle parking facilities generally lack any complimentary facilities. In areas where a large number of outdoor (Class II or Class B) bicycle parking spaces are concentrated, an air pumping station is sometimes provided (see Figure 21 and Figure 22).

Figure 21 - Free air pump at the Weisman Museum in Minneapolis, Minnesota

Photo: Matthew Cole

Figure 22 - Bicycle air pump next to a bicycle traffic counter in Copenhagen, Denmark

Photo: Matthew Blackett/Spacing Magazine

3.3 Long-Term Parking Facilities

3.3.1 Location

In the case of long-term parking, proximity to the destination is less critical than for short-term parking. Nonetheless, every effort should be made to locate parking in a convenient location that minimizes walking distance between parking and the destination – e.g., a primary building entrance, a storefront, a transit station platform, etc. A walking distance of 30 to 50 metres from the bicycle parking facility to the destination is considered acceptable (Celis and Bølling-Ladegaard, 2008).

On-site long-term bicycle facilities can be located either outdoors or indoors. If outdoors, facilities such as sheds, cages, or bicycle lockers should be placed close to the destination that they are intended to serve. If they serve a building, they should be located close to an entrance. If they serve a transit station, they should be located close to vehicle boarding platforms.

If indoors, long-term bicycle parking facilities can be located within an automobile parking garage or a room that is easily accessible from the outdoors. It is preferable that they be at grade. If not at grade, they should be accessible without the use of stairs or an elevator – i.e., via a ramp. If in a garage, it is preferable that they be located near an entrance from the garage to the building.

If long-term bicycle parking is not in a visible location (i.e., because it is indoors or behind a building), signage should be provided to direct cyclists to the parking facility.

3.3.2 Design

The bicycle stands and racks described in Section 3.1.2 can be used both for short- and long-term parking applications. In long-term parking facilities, the convenience of moving a bicycle in and out of parking berths is a less important preoccupation than for short-term parking as bicycle turnover is low. Stands or vertical elements on racks can therefore be placed closer together, allowing a greater density of parked bicycles.

Stands or racks intended for long-term parking are usually placed in some kind of enclosure. The enclosure can take a variety of forms: it can be provided by an existing structure, such as part of a building or a parking garage, or it can be provided by a purpose-built structure. Alternatively, instead of providing stands or racks in an enclosed space, long-term parking can instead consist of a set of lockers, or individual enclosures large enough to fit one bicycle each. The subsections below describe popular approaches for the design of long-term parking facilities, including common types of enclosures and bicycle lockers.

Long-term bicycle parking facilities at employment centres will often feature complementary infrastructure, especially change rooms and showers. These should be placed as close to the bicycle parking area as possible. The size of the change room and the number of showers provided is usually proportional to the number long-term parking spaces. At large employment sites, separate facilities will be required for men and women. Municipal requirements with regard to the provision of change rooms and showers are discussed in more detail in Section 5.2.

Sheds

A bicycle shed is a roof or partial enclosure over a bicycle area. Sheds can be freestanding structures (Figure 23 and Figure 24) or can be awnings or berths attached to a building (Figure 25). Bicycle sheds provide weather protection but, as they are not fully enclosed, they do not necessarily offer improved security. Sheds at GO commuter train stations in the Toronto area, for example, rely on existing camera surveillance on the park-and-ride lots but do not provide any dedicated security measures for bicycles (Figure 23).

Sheds can provide additional services. On-street bicycle sheds in New York City, for example, have a large map of bicycle routes and other facilities (Figure 24). In Copenhagen, some bicycle sheds near shopping streets also provide small baggage lockers, intended to allow users to store belongings that they do not wish to carry with them while shopping (Celis and Bølling-Ladegaard, 2008).

Figure 23 - A bicycle shed at a GO Transit commuter train station in Milton, ON

Photo: Brian Main/GO Transit

Figure 24 - An on-street bicycle shed in New York City

Photo: AllWaysNY.com

Figure 25 - Bicycle sheds at the British Library in London, UK

Photo: Matthew Cole

Bicycle Cages

A bicycle cage is a fenced or walled area enclosing parked bicycles. A key combination code is usually required to access the cage. Bicycle cages can either be located outdoors or indoors. If outdoors, cages usually have an impermeable canopy, similar to a bicycle shed (Figure 26), or are placed under an existing awning or in a covered area. Indoors, cages are created within larger spaces, such as a garage (Figure 27) or a large storage room, in order to limit access to parked bicycles.

Figure 26 – Outdoor bicycle cage at the University of Leeds in Leeds, UK

Photo: University of Leeds

Figure 27 - Indoor bicycle cage within a parking garage

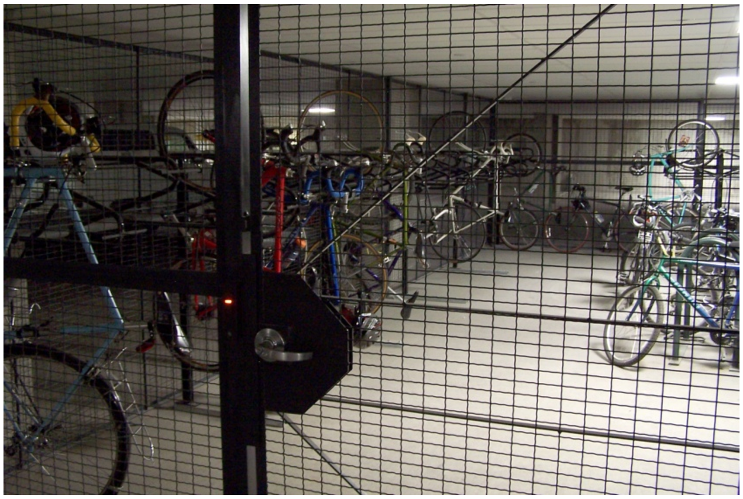

Photo: United States Environmental Protection Agency

Bicycle Lockers

A bicycle locker (Figure 28) is a fully enclosed container large enough to fit a standard bicycle. Being fully enclosed, lockers provide a high level of weather protection. As they are accessible only to one user at a time, they also offer a very high level of security. A further advantage is that they can store more than just bicycles; users can also leave other belongings, such as helmets and bags. A disadvantage is their large footprint—considerably larger than that of bicycle stands or racks. This makes lockers inappropriate for higher capacity applications as bicycle sheds or cages are more space efficient.

Bicycle lockers are accessed using a key, a combination code, or a coin or credit card operated lock, not unlike those used on baggage lockers. One way of operating bicycle lockers is to require that individuals rent a specific locker for a fixed time period. In this case, the individual is provided with the key or combination specific to their assigned locker. Another way of operating bicycle lockers is on a first come, first served basis, where anyone can use a vacant locker. In this case, the locker will be equipped with a coin or credit card operated locking system.

Figure 28 - Bicycle lockers at a SkyTrain station in Vancouver, BC

Photo: CycleSafe

An innovative variation on the bicycle locker theme is the *Biceberg*, implemented in Barcelona and several other communities in Spain (see case study in Section 6.4.1). Rather than using stationary lockers, the Biceberg uses mobile containers that are stored underground. Above grade, the only visible part of the system is a kiosk roughly the size of a bus shelter (Figure 29). Whenever a user wishes to deposit their bicycle, the Biceberg's robotic control system raises an empty container into the kiosk. After the bicycle and any other belongings have been stowed in the container, the system lowers the container back underground. When the user returns to take out the bicycle, the system retrieves the container and raises it back into the kiosk. Biceberg facilities can store between 46 and 92 bicycles.

The principal advantage of the Biceberg is that it has a very small footprint at grade relative to the number of bicycles that they store. However, Bicebergs require a fairly large volume below grade, which entails heavy construction work and considerable costs. The manufacturer has designed the system to be either placed in a purpose-built underground enclosure or within an existing underground parking structure. It claims that the highest capacity Biceberg, with a capacity of 92 bicycles, would have a footprint equivalent to four automobile parking spaces if installed in an existing garage (Bikeoff, 2008 a).

Figure 29 - Biceberg automated bicycle contained storage system in Barcelona, Spain

Photo: Biceberg

3.4 Bicycle Stations

3.4.1 Location

Bicycle stations are defined here as high capacity bicycle long-term parking facilities open to the general public. Facilities of this type are placed in proximity to major transit hubs, educational campuses, and high-density employment areas—i.e., near land uses that generate a very large number of trips. According to a Danish manual on bicycle parking design (Celis and Bølling-Ladegaard, 2008), high capacity public bicycle parking facilities should be located within 100 metres of a major trip generator. Beyond 100 metres, cyclists will tend to try to find parking closer to the destination.

Where there are multiple trip generating foci, a bicycle station should be placed in a central location. A central bicycle station would be placed for example on a university campus, in an office park, or in downtown business district—i.e., all situations where a large number bicycle commuters are dispersed across a number of buildings.

3.4.2 Design

Bicycle stations can be standalone structures, either aboveground or underground, or can placed within another structure, such as an existing garage or building. Bicycle stations are usually located in central urban areas, where land values are extremely high, a key design consideration is maximizing the number of bicycle parking spaces relative to the floor area. A common approach is to use so-called 'two-tier' bicycle racks, which allow bicycles to be stacked in two layers. On the top level, each bicycle stand consists of a moveable ramp, which can be slid out and tilted down to floor level for loading and unloading the bicycle (Figure 30). To fit two-tier racks, a 2.7 metres floor-to-ceiling clearance is required (Cycle-Works, undated).

Figure 30 - Bicycle station at Union Station in Washington, DC

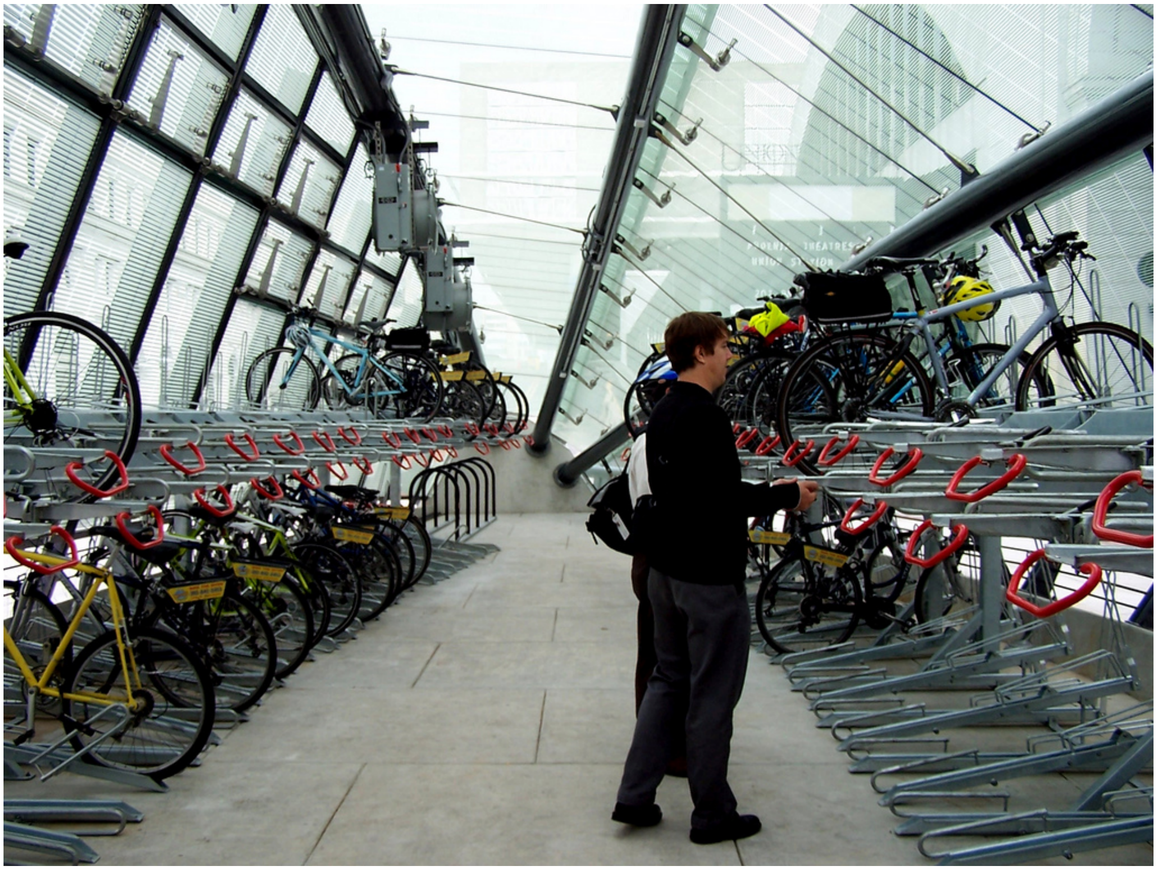

Photo: BeyondDC

If available space at grade is limited, a possible option for maximizing the density of parked bicycles is to build a multi-level station. In this case, ramps with gentle grades should link each level. In addition, an elevator deep enough to fit the length of a bicycle could be provided.[2] Another, albeit much more expensive possibility is to build an underground facility (see Section 4.1.1 for more details on cost). As with a multi-level facility above grade, access from grade to the parking level must be via a gently sloped ramp (Figure 31) and optionally an elevator.

[2] An elevator would allow less physically able users, especially seniors, to access the upper levels. However, an elevator would greatly increase the capital and operating costs of the bicycle station. An alternative way to address the issue is to give seniors and other physically challenged users priority access to ground level parking.

Figure 31 - Access ramp to an underground bicycle station in Amsterdam, Netherlands

Photo: Bikeoff.org

Bicycle stations commonly restrict access to bicycle parking areas to paying users for increased security. Access to bicycle parking areas can either be controlled by an attendant in the case of a staffed station or by means of an electronic identification system at unstaffed locations. Typically, 'man trap' type doors (Figure 32) are used at unattended access points to prevent unauthorized individuals from following others into the bicycle parking area. In the Netherlands, it is common for bicycle stations to offer both some open access areas, which are free of charge, and limited access areas offering higher security, accessible by swipe card for a nominal fee (Bikeoff, 2008 a).

Figure 32 - Swipe card operated access gate at a bicycle station in Amsterdam, Netherlands

Photo: Bikeoff.org

In addition to secure bicycle parking, bicycle stations can offer a variety of complementary services. These can include:

- toilets
- showers
- change rooms
- day use lockers
- vending machines or kiosks bicycle parts and accessories
- bicycle service
- air pumps
- maps and information
- vending machines or kiosks with food and beverages

For example, the bicycle station at Union Station in Toronto (see Case Study) includes: a change room; a mechanic stand and a variety of bicycle tools, which customers can use at no additional cost; a vending machine with emergency bike necessities such as tubes, tire levers, patch kits; and a vending machine with beverages.

4 Cost

This chapter addresses the costs of building and operating bicycle parking facilities. As many of the actual costs are liable to be location-specific, the approach taken here is to identify the principal cost factors. Knowing what these factors are should help users of this guide to make cost estimates specific to their context. Examples and cost ranges are provided where relevant and where data is available. The chapter also addresses potential revenues generated through user fees and other sources, which can offset the costs.

The **capital costs** of developing bicycle parking infrastructure can be broken down into three main categories:

- the cost of bicycle stands or racks, including material and labour for installation
- the cost of the enclosure, if one is provided, including material and labour costs for construction
- the cost of land.

Most types of short- and long-term bicycle parking facilities do not have significant **operating costs**. Only bicycle lockers and bicycle stations are likely to have significant operating costs. The main cost factors are expected to be:

- human resources for maintenance and cleaning
- human resources for customer service and security
- utility costs
- forgone revenues if bicycle parking replaces paid automobile parking

Bicycle parking facilities that charge user fees can generate revenues that help recover capital costs and cover operating costs. Aside from user fees, other sources of revenue can include advertising and, in the case of bicycle stations, sales of bicycle parts and accessories and bicycle maintenance services.

4.1 Short-Term Bicycle Parking

4.1.1 Capital Costs

On a per parking space basis, unprotected outdoor bicycle stands or racks are the cheapest to provide. The only significant cost is the cost of the stands themselves. A single inverted 'U' or post-and-ring stand, which accommodates two bicycles, costs roughly \$100-\$150 or \$50-\$75 per bicycle parking space (City of Ann Arbor, 2008; PBIC, undated). There are usually no further costs, given that there are no enclosures or structures to be built and usually no new land needs to be acquired.

4.1.2 Operating Costs

Most unprotected outdoor bicycle stands will not entail any significant operating costs. Other than cleaning the surface on which they stand, bicycle racks do not require any regular maintenance. The cleaning of bicycle parking areas can be integrated into regular street cleaning or grounds keeping procedures; dedicated capital and human resources are not required.

Short-term bicycle parking that replaces an on-street automobile parking space can in principle have an operating cost. If the automobile parking space was a paid space, the municipality may be forgoing automobile parking revenues from that space. For example, a downtown, on-street parking space with a $6 per hour rate charged 12 hours a day, seven days a week, used 90% of the time would generate revenues of almost $24,000 per year, plus the added revenue of parking tickets. Assuming 12 bicycle spaces replace a single automobile parking space, the forgone revenue would amount to $2,000 per bicycle parking space per year. Furthermore, the cost of maintaining the bike rack must be taken into consideration.

4.1.3 Revenues

As the use of short-term bicycle parking facilities is generally free, there are usually no revenues generated. It is however possible to place advertising on outdoor bicycle racks (Figure 33 and Figure 34), which can generate revenues.

Figure 33 - Bicycle rack with advertising

Photo: Street Media

Figure 34 - Bicycle Shelter with Advertising

Photo: Jason Varone/Streetsblog.org

4.2 Long-Term Bicycle Parking

4.2.1 Capital Costs

Long-term parking facilities can utilize the same types of stands and racks as short-term parking facilities, such as inverted 'U' or post-and-ring rack, costing $75 to $150 per bicycle parking space, as mentioned above. Long-term parking facilities can also utilize more space efficient bicycle supports. For example, wall-mounted supports for use in garages or indoors, cost from $20 to $300 apiece[3]. Two-tier bicycle racks, which allow bicycles to be stacked on two levels, cost $350 to $400 per bicycle (Bikeoff, 2008 b).

A canopy or shelter for weather protection for twenty bicycles could cost anywhere between $5,000 and $15,000 ($250 to $750 per bicycle), depending on the quality of the design and materials used (Bikeoff, 2008 b). This expense can be avoided by placing the facility under an existing awning, in a garage, or in a room indoors.

A free-standing, fully enclosed bicycle cage is estimated to cost between $300 to $400 per bicycle, including bicycle stands (UBC, 2006). The cost can be lowered by placing the facility next to a building or in a garage and using existing walls to reduce the amount of material required to create a secure enclosure.

Bicycle lockers are considerably more expensive. A single bicycle locker can cost from $1,000 to $2,500, depending on the model (UBC, 2006; City of Ann Arbor, 2008). In comparison, the *Biceberg* underground container storage system costs between $2,400 per space (with 92 bicycle capacity) and $3,900 per space (with 46 bicycle total capacity), including hardware and construction costs.

[3] The lower end of the range is the price for a simple wall-mounting hook, which does not allow for the use of a 'U' shaped lock. The upper end of the range is the price for a higher end wall-mounting rack with bars allowing for the use of a 'U' shaped lock.

In most cases, it will not be necessary to acquire new land to implement an on-site long-term parking facility. However, it might be necessary to sacrifice revenue generating parking spaces in a garage or a rentable room inside a building.

4.2.2 Operating Costs

Most long-term bicycle parking facilities, such as bicycle sheds, cages and lockers, do not entail any significant operating costs. Sheds and cages, particularly if outdoors, will require regular cleaning. As with short-term bicycle parking, this can be integrated into regular street cleaning or grounds keeping procedures. In most cases, additional capital and human resources will not be required for this purpose. Unless a dedicated surveillance system is implemented within the parking facility, there will be no cost for security.

An automated long-term bicycle parking system, such as the *Biceberg*, in contrast can entail significant operating costs. Its mechanical and electronic systems require regular inspections and maintenance. The parking system draws electric power and will therefore entail utility costs. Data on the operating costs of *Biceberg* were not available at the time of writing.

If long-term parking replaces paid automobile parking in a garage, the owner of the garage may forgo significant revenues. For example, a downtown multi-level parking garage that charges $8 per hour, 24 hours seven days per week operating on average at 40% capacity would generate annual revenues of about $35,000 per automobile per space. Assuming 12 bicycle parking spaces replace a single automobile parking space, forgone revenues would amount to $2,900 per bicycle parking space per year.

4.2.3 Revenues

User fees are not uncommon at public long-term bicycle parking facilities that offer a higher level of security, such as bicycle cages or bicycle lockers. A few examples are listed below:

- City of Toronto charges $10 for renting a bicycle locker for four months ($2.50 per month)
- Translink, the Metro Vancouver public transit authority, charges $30 for use of bicycle lockers at SkyTrain (light rail) stations for three months ($10 per month)
- *Biceberg* automated parking systems in Barcelona, Spain charge a system access fee of €6 ($9) and a usage fee of €0.30 ($0.40) per hour

4.3 Bicycle Stations

4.3.1 Capital Costs

The capital costs of bicycle stations can vary widely on a per bicycle space basis. Factors that potentially influence cost include whether the station is placed within an existing building or a new, purpose built building; the architectural quality of the building, if new; and the number and types of complementary services (such as showers, change rooms, lockers, shops, and services) that are to be accommodated within the station. Furthermore, stations in downtown locations are liable to be more costly due to elevated land costs and space restrictions, which may require the station to feature multiple levels or to be placed underground.

A few examples include:

- the 180 bicycle Union Bicycle Station in Toronto (see Case Study) was implemented within an existing structure at a cost of $400,000 or $2,200 per bicycle parking space

- the 300 bicycle McDonald's Cycle Center in Chicago (see Case Study) is located in a purpose built building and cost $3.3 M or $11,000 per bicycle parking space

- the 3,000 bicycle Bike Flat in Amsterdam, a purpose built multi-level aboveground bicycle parking facility cost about $3.5 M or $1,400 per bicycle parking space (Bikeoff, 2008 a)

- the 3,000 bicycle and 50 scooter Zutphen station in Amsterdam, a purpose built underground facility, cost roughly $6 M or $2,000 per parking space (Bikeoff, 2008 a)

4.3.2 Operating Costs

As with capital costs, operating costs of bicycle stations can vary widely. Operating costs are likely to be strongly affected by staffing, especially smaller facilities. Unstaffed locations with automated access are likely to have lower total operating costs than staffed locations of the same capacity. Larger facilities can allow for economies of scale in terms of staffing—i.e., the cost per parking space of having a staff member on duty will decrease as capacity increases.

A few examples include:

- the 180 bicycle Union Bicycle Station in Toronto (see Case Study) is minimally staffed (total 16 hours per week) and costs $50,000 per year to operate, or $280 per parking space

- the 3,000 bicycle and 50 scooter Zutphen underground bicycle parking facility in Amsterdam is staffed daily from 5:30 AM until 1:30 AM (total 140 hours per week) and costs about $220,000 per year to operate, or $70 per parking space (Bikeoff, 2008 a)

- the 2,000 bicycle Amsterdam Zuid underground bicycle parking facility is also staffed 20 hours per day (140 hours per week) and costs about

$356,000 per year to operate, or $180 per bicycle parking space (Bikeoff, 2008)[4]

4.3.3 Revenues

It is common for bicycle stations to charge user fees. In most cases, there is a daily rate for casual users and monthly rates for frequent users. A few examples, taken from the case studies in Section 6, include:

- the Union Bicycle Station in Toronto charges $2 a day for casual user, or $20 for a one-month pass or $60 for a four-month pass, plus a $25 onetime administration fee for pass holders only)
- the McDonald's Bicycle Center in Chicago charges US$25 per month or US$150 per year, plus a US$25 onetime administration fee, for access to its secure parking area, lockers, and showers; lower security bicycle parking is available for use free of charge
- bicycle stations operated by Bikestation in several US cities, including several municipalities in the San Francisco Bay Area, Seattle, and Washington DC, charge a US$1 for day passes, US$12 for monthly passes, and US$96 for annual passes, plus a US$20 onetime registration charge of for all users

[4] The facility has luggage escalators for access between grade and parking level, which improves accessibly for less physically able users but increases its operating cost considerably.

5 Incentives and Regulations

The implementation of bicycle end-of-trip facilities is a responsibility that is shared between public authorities and private landowners in most communities. Public authorities, or agencies acting on their behalf, are responsible for the provision of bicycle end-of-trip facilities on streets, at parks and public facilities, and at transit hubs. However, the responsibility for the provision of indoor and outdoor bicycle end-of-trip facilities at residential, commercial, industrial, and all other private properties belongs to the owners of those properties.

There are many reasons for investing in bicycle end-of-trip facilities on private properties, especially for businesses. The key reasons include:

- increasing overall parking capacity at little cost
- gaining a competitive advantage by attracting bicycling customers
- attracting and retaining health and environment conscious employees
- reducing clutter, hazards for pedestrians and automobiles, and tree damage from unplanned bicycle parking
- mitigating the environmental impacts related to employees and customers travelling by automobile

Although the responsibility lies with property owners, the municipality can play a crucial role in enabling the provision and ensuring the quality and sufficient capacity of private bicycle end-of-trip facilities. This chapter examines different approaches to that municipalities can undertake to influence the provision of end-of-trip facilities at private properties. The approaches fall into two broad categories: (1) incentives, which are intended to drive the voluntary provision of end-of-trip facilities, and (2) regulations, which can be used to impose mandatory provision of bicycle end-of-trip facilities. Municipalities can adopt one or the other approach, or a combination of the two.

5.1 Incentives

Municipalities can create a variety of incentives to help drive the creation of bicycle parking facilities in the private realm.

5.1.1 Promotional Materials

One way to promote the creation of bicycle parking in the private realm is to distribute promotional materials to local businesses and property owners. The materials should highlight the benefits of providing bicycle parking for clients and employees. There should also be basic information on where to locate and how to design effective bicycle parking and complementary facilities, similar to the information presented in Chapter 3 of this guide. Examples of cities that have produced promotional materials on bicycle parking targeted at businesses and developers include the City of Ann Arbor (2008), the City of Calgary (2002), and the City of Chicago (2002) (Figure 35).

Figure 35 - Bicycle parking brochures

Illustration: montage of images from City of Ann Arbor (2008), City of Calgary (2002), City of Chicago (2002).

5.1.2 Awards Programs

The municipality can hold an annual contest to recognize businesses or organizations that have made great efforts to promote bicycle use among their clients and employees. For example, since 2001, the City of Toronto has been giving out annual *Bicycle Friendly Business Awards* to organizations that have proven their commitment to cycling, particularly through the development of high quality bicycle parking, shower, and change room facilities. All of the awards distributed to date are listed on the Bicycle Friendly Business Awards page on the City of Toronto website.

5.1.3 Financial Incentives

Municipalities can provide financial incentives, either in the form of grants or in the form of tax breaks, in order to encourage development of bicycle end-of-trip facilities. A granting program could be setup to help defray costs of parking infrastructure and complementary facilities, such as showers and change rooms. For example, under a congestion relief program, San Mateo County in California reimburses business 50% of the cost of installing secure bicycle parking, such bicycle cages or lockers. The County reimburses up to US$500 per unit of bicycle parking (San Mateo County, 2009). Also in California, Santa Cruz County provides any business, public agency, or non-profit organization with up to eight inverted-U bicycle stands free of charge or provide a subsidy of up to US$1,000 towards the purchase of any other eligible type of bicycle stand or rack. The County also provides subsidies of US$500 towards the purchase of a double-bicycle locker (US$250 per bicycle stall) (SCCRTC, 2009).

5.1.4 Parking By-Law Incentives

Another possible strategy for encouraging the provision of bicycle parking is to reduce the required minimum number of automobile parking spaces at new developments in exchange for the provision of bicycle parking spaces. This can be especially effective where developers must build garages to meet minimum parking requirements, which entail high costs. Communities that use this incentive include the City of Portland in Oregon (Litman, 2009) and the City of Pittsburgh in Pennsylvania (City of Pittsburgh, 2009). In both cases, there is a ceiling on the number of automobile parking stalls that can be eliminated through the provision of bicycle parking; automobile parking cannot be entirely substituted for bicycle parking.

5.2 Regulations

Most Canadian municipalities have zoning or land use by-laws that regulate development of land within their boundaries. Just as these by-laws can be used to prescribe the provision of automobile parking, they can also be used to prescribe the provision of bicycle end-of-trip facilities. This is being done by an increasing number of municipalities in North America.

As described in Section 2.1.1, the demand for bicycle facilities varies with land use. For this reason, municipalities that regulate the provision of end-of-trip facilities on private properties usually have different requirements for each land use specified in the zoning or land use by-law. The requirements are usually broken down into a requirement for so-called *Class I* or *Class A* bicycle parking, which is essentially long-term parking with a relatively high level of service; and *Class II* or *Class B* bicycle parking, which is essentially intended to be short-term parking. Class I or A parking is supposed to have a higher level of service, meaning better theft and weather protection than basic Class II or B parking. Some municipalities, such as Vancouver, also require the provision of showers and change rooms at employment land uses. In this case, however, the required number of showers and change rooms is not directly tied to land use; instead, it is tied to the required number of Class I or A bicycle parking spaces.

The metrics used to specify the required number of bicycle parking spaces vary across land uses. For example, for residential land uses, the requirement of automobile and bicycle parking spots is usually tied to the number of dwelling units on a given property; the greater the number of units, the more bicycle parking is required. In the case of commercial and industrial land uses, floor area is used to determine bicycle parking capacity. For educational institutions, the required numbers of the two types of bicycle parking spaces are proportional to the number of students and faculty members. Some municipalities, such as Portland, Oregon, require that commercial parking garages provide a certain number of bicycle parking spaces proportional to the number of automobile parking spaces that they contain.

Table 2 and Table 3 below provide examples of actual requirements for bicycle parking in two municipalities – Calgary, Alberta and Portland, Oregon respectively. Though the two municipalities define their land use categories slightly differently, there are still several categories that are comparable. For example, in both cases, the number of dwelling units in a multi-family residential property is used to determine short- and long-term parking capacity. Similarly, the required number of bicycle spaces for commercial and industrial uses is essentially specified in terms of floor area in both cases, even though each city accounts for this slightly differently (*gross floor area* versus *net building area*).

Table 2 – City of Calgary bicycle parking requirements for different land uses

Land Use Category	Short-term Spaces	Long-term Spaces
Residential		
Single Family or Duplex	not required	not required
Multi-Family (under 20 units)	minimum 6	not required
Multi-Family (20 units and over)	1 per 10 units minimum of 6	1 per 2 units
Commercial		
Downtown Office	1 per 1,000 m^2 gross floor area	1 per 600 m^2 gross floor area
Non-downtown Office	minimum 6	1 per 1,000 m^2 gross floor area
Individual Retail Establishment	1 per 250 m^2 gross floor area minimum 4	not required
Enclosed Shopping Mall	1 per 33 automobile spaces	1 per 50 automobile spaces
Regional or Neighbourhood Shopping Centre	1 per 20 automobile spaces	none
Parkade	1 per 40 automobile spaces	1 per 40 automobile spaces
Industrial		
All Sites	1 per 1,000 m^2 gross floor area	not required
Institutional		
Elementary or Secondary School	1 per 10 students	1 for every 30 employees
College or University	1 per 33 students	1 per 33 staff + students
Hospital	1 per 1,000 m^2 gross floor area	1 per 25 employees
Cultural and Recreational		
All Sites	not required	1 per 10 automobile spaces
Transit		
LRT stations	minimum 10	minimum 8

Adapted from City of Calgary (2002)

Table 3 - City of Portland bicycle parking requirements for different land uses

Land Use Category	Short-term Spaces	Long-term Spaces
Residential		
Single-Family or Duplex	no requirement	no requirement
Multi-Family	1 per 20 units minimum 2	1 per 4 units
Dormitory	no requirement	1 per 8 residents
Commercial		
Office	1 per 3,700 m^2 net building area minimum 2	2, or 1 per 900 m^2 of net building area
Retail Sales And Service	1 per 450 m^2 net building area minimum 2	1 per 1,100 m^2 of net building area minimum 2
Hotel or Temporary Lodging	1 per 20 rentable rooms minimum 2	1 per 20 rentable rooms minimum 2
Parkade	no requirement	1 per 20 automobile spaces minimum 10
Industrial		
Manufacturing and Production	no requirement	1 per 1,400 m^2 net building area minimum 2
Warehouse and Freight Movement	no requirement	1 per 3,700 m^2 net building area minimum 2
Institutional		
Elementary School	no requirement	2 per classroom or as determined by planning review
Secondary School	no requirement	4 per classroom or as determined by planning review
College or University	1 per 900 m^2 net building area minimum 2 OR subject to planning review	1 per 1,800 m^2 net building area minimum 2 OR subject to planning review
Hospitals or Medical Centers	1 per 3,700 m^2 net building area minimum 2 OR subject to planning review	1 per 6,500 m^2 net building area minimum 2 OR subject to planning review
Community Service	1 per 900 m^2 net building area minimum 2	1 per 900 m^2 net building area minimum 2
Religious Institutions	1 per 180 m^2 net building area minimum 2	1 per 370 m^2 net building area minimum 2
Daycare	no requirement	1 per 900 m^2 net building area minimum 2
Cultural and Recreational		
Parks and Open Areas (Public)	subject to planning review	subject to planning review

Outdoor Recreation (Commercial)	no requirement	1 per 20 automobile spaces minimum 10
Major Event Entertainment	no requirement	1 per 40 seats minimum 10 OR subject to planning review
Transit		
LRT Stations or Transit Centres	no requirement	1 per 800 m^2 station area minimum 10

Adapted from City of Portland (2010)

Table 4 below provides an example of change room and shower requirements in the City of Vancouver. Whereas parking requirements are tied directly to measures of land use, requirements for change rooms and showers are tied to the number of long-term bicycle parking spaces provided on a given property. The City of Vancouver requires that all properties that must provide at least four long-term parking spaces (called Class A bicycle parking stalls in Vancouver) must also provide a change room, equipped with a toilet and sink, and a shower. The required number of toilets, sinks, and showers increases proportionally to the number of required long-term bicycle parking spaces at a rate of one additional toilet and shower for every 30 and one additional sink for every 60 bicycle parking spaces.

Table 4 – City of Vancouver change room and shower requirements for long-term bicycle parking facilities

Long-Term Bicycle Parking Stalls	Number of Toilets*	Number of Sinks*	Number of Showers*
0-3	0	0	0
4-29	1	1	1
30-64	2	1	2
65-94	3	2	3
95-129	4	2	4
130-159	5	3	5
160-194	6	3	6
Over 194	+1 for each additional 30 bike spaces or part thereof	+1 for each additional 60 bike spaces or part thereof	+1 for each additional 30 bike spaces or part thereof

Adapted from City of Vancouver (1995)

* separate facilities required for each sex therefore actual number required is double

6 Case Studies

6.1 Union Bicycle Station – Toronto, Ontario

6.1.1 Basic Information

Project name	Union Bicycle Station
Location	Union Station, Toronto Ontario.
Opening dates	May 2009
Type of facility	bicycle station built into an existing structure
Capacity	180 with additional units planned.
Users	general public with or without membership
User fees	$2 day parking for casual users memberships $20 for one month or $60 for four months plus $25 onetime registration fee
Capital cost (total)	$400,000
Capital cost (per space)	$2,200
Operating costs (total)	$50,000 per year
Operating costs (per space)	$280 per year

6.1.2 Overview

The Toronto Union Bike Station is the first and so far only public bicycle station in Canada. The facility is located beneath the commuter and inter-city train platforms at Union Station, the city's primary transit hub, located in the downtown core. The facility is to be built in three phases. The first phase was completed in the spring of 2009, providing 180 bicycle parking spaces plus change rooms and a washroom. If the remaining two phases are completed according to plan, the facility will have a total of 600 bicycle parking spaces.

6.1.3 Location and Context

The first and currently only built portion of the Union Bicycle Station is located on the west side of Union Station in downtown Toronto. Union Station is Toronto's main train station and is a key intermodal transit node in the Greater Toronto Area, being served by inter-city and commuter rail, subway, and streetcars. The station is located within Toronto's large and very dense central business district, which attracts tens of thousands of commuters daily.

Figure 36 - Location of the Toronto Union Bike Station

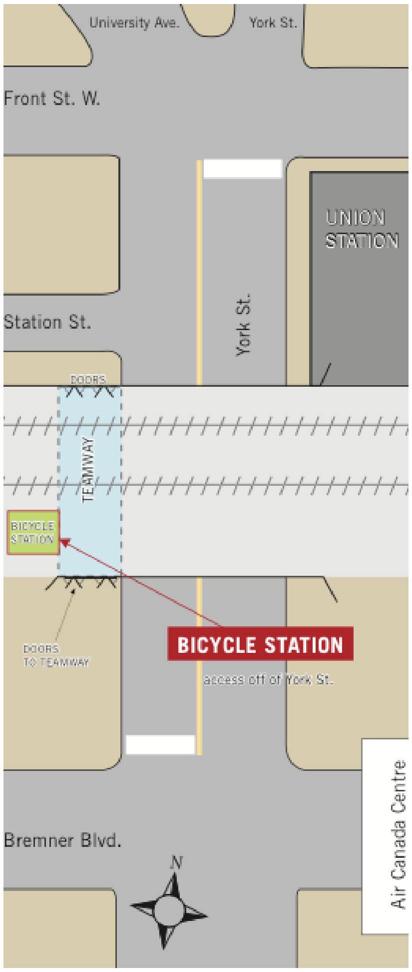

Illustration: City of Toronto

6.1.4 Stakeholders

The construction of the Bicycle Station was part of the City of Toronto's planned revitalization of Union Station. A central body was created to oversee the project called the Union Station Revitalization Advisory Committee (USRAC) which collaborated with interested members of the public, the Toronto Cycling Committee[5], and city councillors to decide on the best design and implementation of a secure bicycle parking facility in the station.

6.1.5 Planning and Implementation

Plans to build the facility began ten years prior to its construction in 1999, with Toronto City Councillor Kyle Rae speaking on behalf of fellow councillor Jack Layton, requesting funding for the creation of a transportation hub at Union station. After

[5] The Toronto Cycling Committee is advises City Council and its departments, agencies, boards, and commissions on the design, development, and delivery of bicycle policies, programs, and facilities to promote and enhance cycling within the City of Toronto. Members of the committee include one city councillor and eight citizens selected through a special committee appointment process.

years of negotiation and planning, the first stage of the facility was completed in the station, with additional facilities planned for the future.

As the City of Toronto began planning the revitalization of Union Station, the Toronto Cycling Committee took the opportunity to formally propose the addition of a secure bicycle parking facility as part of the renovations. The idea of a bicycle parking facility was then put forward by Pauline Craig (Cycling and Transit Project Organizer) at a Union Station revitalization public advisory meeting. Expanding on the Cycling Committee's proposal, the installation of bicycle lockers was also debated. Planning staff, for security reasons, rejected the lockers but approved proposals for short- and long-term bicycle parking designs.

In July 2007, city planning staff put forward their final proposal recommending an indoor bike parking facility with 24 hour access and security. Two potential locations were chosen but rejected because the space was needed for retail and automobile parking. A final scheme was eventually approved by USRAC in October 2007, proposing that the project be built in three phases during the renovation period. The first stage would be a 200 $metre^2$ space with room for 180 bicycles, built in the York West Teamway, a pedestrian passage beneath the train station platforms. The first stage was completed in the spring and opened in May 2009. A proposed second stage would accommodate 120 more bicycles and a third would accommodate an additional 300.

6.1.6 Design

The facility is located in an enclosed space beneath the Union Station railway platforms. Access to the bicycle parking area is controlled by an electronic key card operated gate. The parking area has a total of 180 bicycle parking spaces provided using two-tier (i.e., stacked) bicycle racks. Users must provide their own locks, as the racks do not have built-in bicycle locking devices. Change rooms and washrooms are provided within the facility but there are, as of yet, no showers.

The first phase of the bicycle parking facility was designed and built to be temporary and can be easily disassembled. As the future phases are built, the current portion of the facility is to be made permanent.

6.1.7 Operations and Services

The station is accessible 24 hours per day, seven days per week using electronic key cards. Staffed hours are only Tuesday to Friday, 4 pm to 8 pm. Memberships and renewals can only be purchased during staffed hours.

The bicycle station is open to the general public with a membership or on a per use basis. Bicycles can be left overnight but cannot be left for longer than 48 hours at a time, with the exception of weekends or on holidays. Members are also allowed to leave their bicycles in the facility longer during periods of inclement weather.

All users, including members and casual day users, have access to change rooms and a washroom. A repair stand, tools, and air pump are also provided to users for the benefit of all users. In case of breakdown, a few shared bicycles are available for emergency use by members only.

Currently, there are no lockers or shower facilities on-site. Future additions to the facility are to include showers. In the meantime, users may use shower facilities at a nearby gym during their regular operating hours. It is possible that lockers will also be added during a future expansion of the facility.

6.1.8 User Fees

To buy a membership, a one-time registration fee of $25 must be paid. Two membership plans are available: a one month plan for $20 or a four month plan for $60. Aside from unlimited access to the facility, other membership benefits include: a 10% discount at participating bike shops in Toronto; a free Bicycle Station t-shirt; and a free City of Toronto bike map.

Casual users who do not have a membership can use the facility for $2 per day.

6.1.9 Costs

Capital costs for the Bicycle Station have been covered by the City of Toronto Transportation Services Cycling Mobility Department. The first phase of the project cost approximately $400,000 to build. The current annual operating costs are estimated at around $50 000.

6.1.10 Outcomes

The first phase of the Bicycle Station project is considered a success. The station received very favourable media coverage at the time of its opening. In the first month of operation, over 100 memberships were purchased. A strike by Union Station staff three months after the opening shut the facility down for six months, stopping the momentum created by the successful launch. The City has received a number of requests to build similar facilities in other locations. Planners are currently considering several such facilities.

6.1.11 Next Steps

Work on Phase Two and Three of the Union Bike Station are set to begin in the near future. The completion of the phases would bring the total parking capacity up to approximately 600 bicycles. Planners are considering as many as fourteen additional facilities at other locations across the city. The locations being considered include mainly transit stations as well as in major public spaces in the downtown core, such as at Nathan Phillips Square and Mel Lastman Square.

6.1.12 Sources

Websites

City of Toronto: Cycling in Toronto – Toronto Union Bicycle Station
www.toronto.ca/cycling/bicycle-station/

6.2 McDonald's Cycle Center – Chicago, Illinois

6.2.1 Basic Information

Project name	McDonald's Cycle Center
Location	Chicago, Illinois
Opening date	July 2004
Type of facility	standalone public bicycle station
Capacity	300
Users	general public with or without membership
User fees	free day parking for all users membership required for overnight parking memberships US$25 per month or US$149 per year plus US$20 onetime registration fee
Capital cost (total)	US$3.2 M ($3.3 M)
Capital cost (per space)	US$10,667 ($11,000)
Operating costs (total)	unknown
Operating costs (per space)	unknown

6.2.2 Overview

The City of Chicago is pushing itself to be the most bicycle friendly city in North America. After the 1990 Congress Clean Air Act labelled Chicago's air quality as "severe", the city set in motion a campaign to improve the air quality and liveability of Chicago. To achieve this, the City implemented transportation control measures to limit auto travel, and promoting the shift from driving to cycling. Mayor Daley has made it his responsibility to make Chicago one of the most environmentally sustainable cities in North America, implementing green design through the urban fabric and facilitating bicycle transportation in every possible way.

The McDonald's Cycle Center is a bicycle station in Millennium Park in downtown Chicago. In addition to the 300 heated indoor bicycle parking spaces, the facility also provides lockers, showers, a bicycle repair shop, a bicycle rental shop, a snack bar with outdoor summer seating, and other amenities. The facility was designed to encourage cycling to the park and to nearby downtown locations. The facility also accommodates runners and in-line skaters.

6.2.3 Location and Context

The McDonald's Cycle Center is located in Millennium Park, a 24.5 acre (9.9 ha) park and civic centre lying between Chicago's downtown "Loop" business district and the Lake Michigan Waterfront. The park, including the Cycle Center, was completed in 2004 as part of a major urban renewal project. The facility is located in the northeast corner of Millennium Park, at the corner of Randolph Street and Columbus Drive.

Millennium Park itself is a major entertainment and recreational facility that attracts thousands of Chicago residents and tourists daily. The adjacent Loop

District is the densest employment area in metropolitan Chicago and attracts commuters from the across the city and the region during the workweek. The McDonald's Cycle Center is intended to serve employees and patrons of Millennium Park as well as commuters working in the Loop District.

6.2.4 Stakeholders

The City of Chicago created the Bicycle Advisory Council with a mandate to collaborate with local bicycle advocacy groups to make cycling a viable mode of transportation in the city. The council had a crucial role in the planning of the facility. The design and construction of the facility as well as its ongoing operations are overseen by the Chicago Department of Transportation (CDOT).

Capital funding was provided by the CDOT and other City departments as well as by the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), through grant programs for projects that lessen traffic congestion and improve air quality. Since 2006, the facility's operating costs are covered by a US$5 million grant provided by the McDonald's Corporation which will cover operating costs for the next 50 years

Other stakeholders include the companies that operate the repair shop, the rental shop, and the café inside the facility.

6.2.5 Planning and Implementation

With the support of Mayor Richard Daley, the City of Chicago has been pushing to be the most bicycle friendly city in the US under its *Bike 2010 Plan* (now replaced by the *Bike 2015 Plan*). The Bicycle 2010 Plan was among several policy measures adopted by the City to reduce traffic congestion and to improve sustainability. The plan called for creating a network of bicycle lanes across the city, improving bicycle access to public facilities, and creating a large, downtown bicycle parking facility.

The design of the facility began in the summer of 2003, at a time when other US cities had just built or were in the process of planning similar bicycle stations. Construction was completed in June 2004 and the facility was officially opened the next month.

6.2.6 Design

The McDonald's Cycle Center sits atop the Millenium Park underground parking complex, essentially forming the fifth and sixth floors of the complex. It was designed by Muller & Muller Architects. The main component of the 12,000 square foot (1,115 metres^2) facility is a large, fenestrated central atrium, which houses the main bicycle parking area with bicycle racks distributed across the facility's two levels. The type of rack used is the two-tiered *Double Parker* by Josta, a German designer and manufacturer of bicycle parking systems. The racks provide a total of 300 bicycle slots. Lockers, change rooms, and showers are located adjacent to the main atrium, as are a bicycle repair and accessory shop, a bicycle rental shop, a café, and an internet station. Signage has been placed across Millennium Park and the surrounding area in order to direct cyclists towards the parking facility. The facility is housed within the same building as the Chicago Lake Front Bike Police headquarters, adding another measure of security to the bicycle parking facility.

The building has several green design features. Notably, much of the electricity for the facility's lighting and climate control systems is provided by solar photovoltaic panels on the building's roof.

6.2.7 Operations and Services

The McDonald's Cycle Centre is staffed and accessible to the public at large during operating hours. The operating hours are as follows:

Spring and Fall
  Monday – Friday: 6:30 am – 7 pm
  Saturday – Sunday: 10 am – 6 pm

Summer
  Monday – Friday: 6:30 am – 8 pm
  Saturday – Sunday: 8am – 8 pm

Winter
  Monday – Fri 6:30 am – 6:30 pm
  Saturday – Sunday: Closed

Outside these operating hours, the facility is unstaffed (except for security personnel) but remains accessible to members. The repair shop, the rental shop, and the café are all closed outside of operating hours. Shower, change rooms, and locker facilities are available 24 hours a day to members only; non-members do not have access these facilities. Though showers and change rooms are open 24 hours a day, towel service is provided only during operating hours.

The lockers, whose dimensions are 75 cm by 25 cm, are large enough for hanging garments and storing helmets. Members are free to use the lockers as long as needed but must provide their own lock.

6.2.8 User Fees

Use of the bike parking area is free to all and no payment or registration is required. However, if users wish to use the facilities outside of operating hours or want access to the lockers, showers, or towel service, registration and payment of a membership fee is required. Membership is open to Illinois residents and costs US$20 per month or US$149 for an annual pass, plus a one-time registration fee of US$20. Aside from 24 hour access to the bicycle parking area, showers, change rooms, and lockers, are provided. Other benefits of membership include: free access to a bicycle sharing program; a 10% discount on repairs and retail items at the station's bicycle; a $25 discount on a membership for a local car sharing program; and discounts on various activities and events sponsored by the McDonald's Cycle Center.

6.2.9 Costs

The total cost of the design and construction of the Cycle Center was $3.2 million. The construction facility was primarily funded through the federal Congestion

Mitigation and Air Quality program, jointly administered by the US Federal Highway Administration and the Federal Transit Administration under the *Transportation Equity Act for the 21st Century* (TEA-21).

Data on the annual operating costs of the station were unavailable at the time of writing. Since 2006, the facility's operating costs have been underwritten by the McDonald's Corporation. McDonald's donated US$5 million to cover the facility's operating costs for 50 years. This implies that the average annual operating cost would be US$100,000.

6.2.10 Outcomes

Mayor Daley's campaign to promote cycling in the city of Chicago has been highly successful thus far. Through investments in various forms of bicycle infrastructure and by calling on the expertise of the city's bicycle advocacy groups, Chicago has become one of the most bicycle friendly cities in the United States. The McDonald's Cycle Center has played a major role in promoting bicycle use, especially for commuters to the central business district. While the centre's capacity is currently at 300 bicycles, it is often near or at capacity during regular business hours and additional outdoor parking has been provided during special events at the park.

6.2.11 Next Steps

While the city continues to expand its bicycle lane network and increase the number of bicycle racks throughout the city, there are no immediate plans to expand the McDonald's Cycle Center. Its current capacity generally meets demand under normal circumstances.

6.2.12 Sources

Contacts

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Documents

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www.chicagobikestation.com

Millennium Park – Arts and Architecture – Bicycle Parking
www.millenniumpark.org/artandarchitecture/bicycle_parking_factsheet.html

Josta Parksysteme
www.josta.de

6.3 Concordia University Secure Bike Parking Facility – Montreal, Quebec

6.3.1 Basic Information

Project name	The Secure Bike Parking Facility (unofficially named)
Location	Montreal, Quebec
Opening date	May 31, 2010
Type of system	Standard bike racks
Capacity	86
Users	Concordia faculty, staff, and students with membership only
User fees	$30 per trimester plus initial $15 deposit for access card and key
Capital cost (total)	$7,800
Capital cost (per space)	$90
Operating costs (total)	$300 per year
Operating costs (per space)	$3.50 per year

6.3.2 Overview

The Secure Bike Parking Facility—under construction at the time of writing—will be an indoor, long-term parking facility at Concordia University's Sir George Williams Campus in downtown Montreal. In recent years, the university's large population of bicycle commuters have frequently complained about the lack of adequate, long-term bicycle parking facilities on the campus. Until now, only unprotected, outdoor, bicycle parking was available to students and staff. The Secure Bike Parking Facility was spearheaded and designed by Matthew Arnold in 2008, then a student in the university's Department of Geography, Environment and Planning, and continues to be involved with the project. The university has provided full funding for the project, as it is aligned with the university's sustainability and transportation management objectives.

6.3.3 Location and Context

Concordia University's Sir George Williams Campus is located in downtown Montreal, directly adjacent to the city's large, dense central business district. During the fall and winter trimesters, the campus attracts a student body of over 40,000 students. Given its downtown location, the campus has relatively few automobile parking spaces while being richly served by public transportation—two metro lines and several bus lines serve the campus, and a major commuter train station is located nearby. The campus is bisected by the Claire-Morissette bicycle path—a recently built, two-way bicycle track crossing downtown Montreal east-to-west—linking the campus to the city's extensive system of bicycle routes.

Concordia's downtown campus attracts a relatively large number of bicycle commuters, the vast majority of whom are students, inclined to use bicycles for economic reasons and their relative proximity to campus.

Figure 37 - Map of the Concordia University Sir George Williams Campus showing outdoor bicycle parking locations

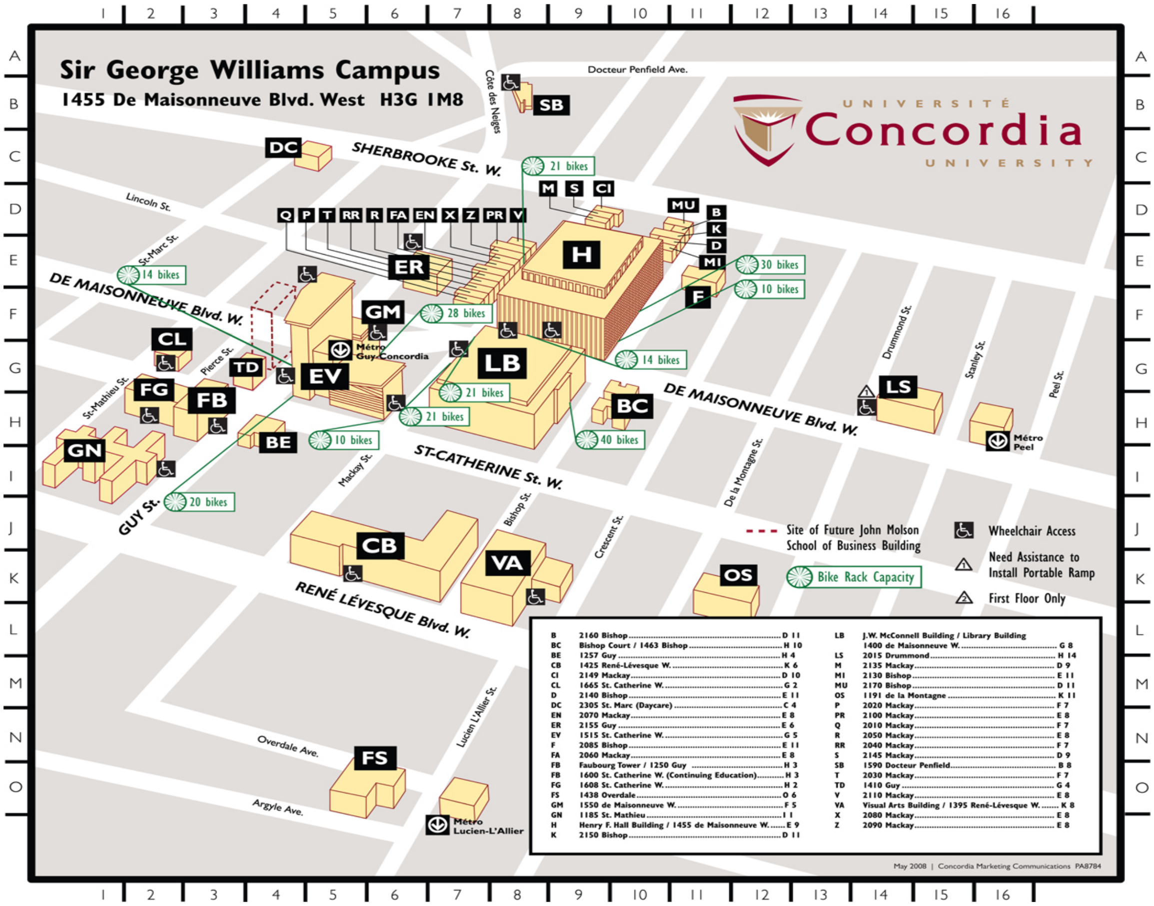

Illustration: Concordia University

6.3.4 Stakeholders

The proposal for secure bicycle parking at Concordia University gained support and moved through to approval quickly. Matthew Arnold and *Allégo Concordia*, a transportation demand management organization, spearheaded the proposal. Allégo Concordia's primary objectives are to promote, educate, and create community involvement with sustainable transportation and campus sustainability. Allégo is funded primarily by Concordia University but lies under a larger umbrella of Sustainable Concordia, a working group of non-governmental organizations associated with the university. Allégo collaborates with other Sustainable Concordia organizations and with other student groups. The organization relies heavily on volunteers.

Allégo Concordia, like Allégo offices at other institutions and businesses in downtown Montreal, was created at the behest of and is financially assisted by the *Agence Métropolitaine de Transport* (AMT), a provincial agency responsible for transportation management and planning in the metropolitan region.

6.3.5 Planning and Implementation

The Secure Bike Parking Facility is being built in response to the ongoing demand for a secure bicycle parking facility on the Sir George Williams campus. As university policy states that bicycles are not permitted inside university buildings, many cyclists have contacted Allégo and the university's building services to know about safe parking alternatives to the common outdoor rack.

The underground parking garage beneath the Library Building (LB on map in Figure 37), which also houses the main library, campus bookstore, administration and student services, an art gallery, and the financial aid offices, has been chosen as the site for the facility. The Library Building garage was chosen because it is both underground and centred on the downtown campus.

In order to implement the bicycle parking facility in the garage, four automobile parking stalls had to be removed. Floor markings in the garage have been repainted to reconfigure automobile parking stalls and guide automobile traffic around the bicycle parking facility. New signage will be added to direct cyclists from street level to the bicycle parking facility.

6.3.6 Design

The bicycle parking facility will be inside an underground garage. Eleven bike racks with spaces for four to eight bicycles are to be bolted to the garage floor in rows, providing a total of 86 bicycle parking spaces. The bicycle racks will be fully enclosed by the existing walls of the garage and a chain link fence supported by a galvanized steel frame. The fence will include a gate with a key lock entry system. This simple design is relatively expensive to build but should provide a high degree of security.

6.3.7 Operations and Services

This unstaffed bicycle parking facility will be accessible 6 a.m. – midnight Monday to Friday, and 9 a.m. – midnight Saturday and Sunday.

By showing their Secure Bike Parking membership card, members will have access to showers, change rooms, and lockers in Concordia University's fitness centre called Le Gym. Shower facilities are only available during Le Gym's operating hours, which 7 AM to 10 PM Monday to Friday, 9 AM to 7 PM Saturday, and 9 AM - 10 PM.

Aside from lockers at Le Gym, which will be free to use for Secure Bike Parking Members, personal lockers can also be rented in several building on campus at a cost of $20 per year.

6.3.8 User Fees

The facility will only be available to members of the Concordia community—i.e., faculty, staff and students—with a valid membership. Memberships will be $30 per trimester, plus a $15 deposit for a magnetic swipe card to access the garage and key to access the bicycle cage. The primary method of registration will be online through the university's personal account page, known as the MyConcordia Portal.

The mandatory $15 refundable key deposit will be returned upon termination of membership, or held in the case of membership renewal. New members will also be required to fill out a brief survey about their bicycle parking needs, such as the times of day at which they expect to use the facility, the level of security they expect, and the complimentary services (showers, lockers, etc.) that they require.

6.3.9 Costs

The budget for construction of the Secure Bike Parking Facility is approximately $7,800. The budget includes raw materials (bicycle racks, fencing material, signage) and labour costs.

The only significant ongoing cost will be that of changing the lock on the facility's fenced enclosure at the beginning of every trimester. This is expected to cost $300 annually. Otherwise, all other operating costs will be absorbed by the existing operating budget for the parking garage. The Allégo coordinator will manage subscriptions and fees, as well as key distribution.

6.3.10 Outcomes

This facility opened on May 31, 2010. It is expected to be successful given the high level of bicycle use, strong bicycle advocacy on campus, and repeated requests for such a facility from faculty, staff, and students. Allégo predicts that users will primarily be faculty and staff, who are more likely to use bicycles of higher quality than those used by most students and who are therefore likely to want a higher level of weather and theft protection. Allégo predicts that demand will be greater during the fall trimester (September to December) than during the spring (January-April) and summer (May-August) trimesters. The lowest demand is expected during the summer, when student enrolment and staffing are lower than during the fall and winter trimesters.

6.3.11 Next Steps

This is a pilot project with nominal investment. Should the project prove to be successful, more funding will likely be allotted for expansion of the facility and to upgrade its security systems. If demand for the facility is high, vertical bicycle racks could be installed to increase the facility's capacity. A magnetic swipe card system could eventually replace the conventional key lock to control access to the bicycle cage.

6.3.12 Sources

Contacts

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Websites

Concordia University
www.concordia.ca

Sustainable Concordia
www.sustainable.concordia.ca

6.4 Bikestation – Various locations in the US

6.4.1 Basic Information

Project name	Bikestation
Locations	Claremont, California Covina, California Long Beach, California Palo Alto, California Santa Barbara, California Seattle, Washington Washington, DC
Opening dates	various dates first Bikestation opened in 1996 (Long Beach) latest opened in 2009 (Washington, DC).
Type of facility	bicycle stations in existing structures standalone bicycle stations
Number of units in station	varies from site to site smallest accommodates 72 bicycles (Seattle) largest accommodates 130 bicycles (Washington)
Users	general public with or without membership
User fees	US$20 annual access fee plus US$2 per day for casual users membership US$96 per year, valid at all Bikestation branded facilities plus US$20 onetime registration fee
Capital cost (total)	varies from US$25,000 to over US$3,000,000
Capital cost (per space)	N/A
Operating costs (total)	unknown
Operating costs (per space)	unknown

6.4.2 Overview

Bikestation is a consulting, management, and development firm that facilitates the development, construction, and management of bicycle parking facilities. Bikestation has developed facilities in several US cities, mostly on the west coast. Most of the facilities are operated as public-private partnerships (PPPs) with municipalities or public transit agencies or as partnerships with educational institutions. The first Bikestation facility was opened in 1996 at the First Street Transit Mall in Long Beach, California. Several other Bikestations of varying capacities and levels of service have since been established. All but two are located in California; the exceptions are Bikestations in Seattle, Washington and in Washington, DC.

6.4.3 Location and Context

Bikestation facilities are generally planned to complement transit facilities, such as LRT stations, bus terminals, or other types of rapid transit hubs. Designated bicycle routes serve most locations. For example, the Long Beach Bikestation is located within the First Street Transit Mall, which is served by LRT and buses and is accessible through the city's shoreline and riverside bicycle paths.

6.4.4 Stakeholders

Bikestation works with various organizations that wish to develop bicycle parking facilities. The company has worked with municipalities, transit agencies, private developers, and parks and recreation departments. The most common partners involved in the development of Bikestation facilities have been municipal agencies, particularly transit agencies. Bikestation's local partners are generally involved in the planning process, helping to select the site and providing land and supporting infrastructure for the bicycle station. Facilities carrying the Bikestation brand name are usually operated by the company itself, with limited involvement of local partners, such is the case in Washington, DC.

6.4.5 Planning and Implementation

In the absence of formal guidelines and accepted practices in the planning and design of bicycle stations in the US, plans for most of Bikestation's facilities have been made on an ad hoc basis, drawing on lessons learned from previous projects. Planning staff at Bikestation work with local government agencies to choose the site and decide on the capacity and range of services to be offered by the bicycle station.

6.4.6 Design

The design of Bikestation facilities varies from location to location. Most facilities are standalone, glass-and-steel sheds with electronic key card controlled access. However, some Bikestations have been integrated into existing structures at transit facilities. Several Bikestations also feature award-winning architecture and public art.

Figure 38 – Bikestation facility in Washington, DC

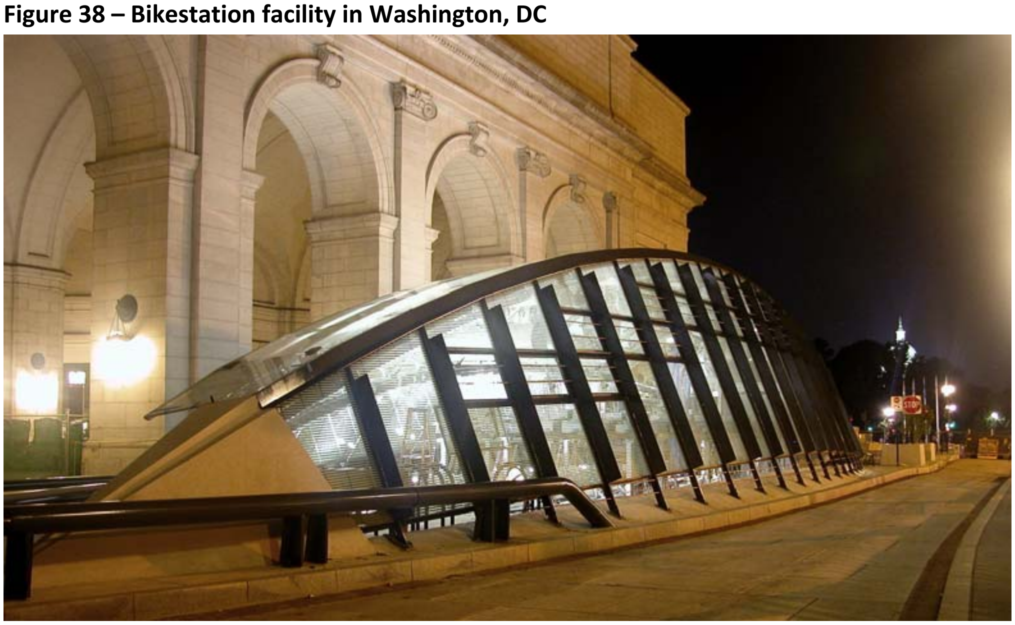

Photo: Bikestation

6.4.7 Operations and Services

Some Bikestations, such as the one at the Covina Metrolink station, are fully automated and require no staff. However, others stations have staff who assist customers in stowing their bicycles or even provide full valet service.

Bicycles are kept indoors in a secured space that is only accessible to Bikestation members. Surveillance is provided by video camera and/or by employees on duty. Some facilities, such as those in Palo Alto and in Washington, DC, feature two-tiered (i.e., stacked) bicycle racks that allow a relatively large number of bicycles to be stored within a relatively small space.

A number of other services and facilities are provided to members either directly by the company or through partnerships with public agencies or private companies. On-site services provided at many Bikestation locations include bicycle repair, air pumps, change rooms, showers, bike rentals, personal lockers, transit and bikeway information, and cafés.

6.4.8 User Fees

Bikestation membership costs and benefits vary somewhat from location to location. Generally, an annual membership costs US$96, plus a US$20 onetime administrative fee. Non-members pay an annual US$20 access fee and US$2 per day each time they use the bicycle station. Some locations allow cyclists to park for free during staff hours but require memberships for overnight parking or access to the facility outside staff hours. Members of any Bikestation facility can use all other Bikestation facilities free of charge.

6.4.9 Costs

According to Bikestation, the least expensive facility to operate is the fully-automated unstaffed facility. This type of bicycle facility has an operating cost of approximately US$25,000 per year. The most expensive facility to operate is the fully staffed, full-service facility. The station costs US$150,000 per year to operate.

6.4.10 Outcomes

Most of Bikestation's bicycle parking facilities have been quite successful. A survey of Bikestation users has indicated that 30% of customers previously commuted by car, suggesting that Bikestations have helped reduce automobile dependence and increased bicycle use.

6.4.11 Next Steps

The company has grown considerably since the construction of its first facility in 1996 and continues to grow as it implements Bikestations in new cities across the US. At the time of writing, the company stated that "several dozen" new Bikestations were under development but did not provide details on the nature and location of these projects.

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Contacts
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info@bikestation.com

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Websites
Bikestation
www.bikestation.com

6.5 Biceberg – Various locations in Spain

6.5.1 Basic Information

Project name	Biceberg
Locations	Barcelona Blanes Huesca Palafrugell Sant Feliú de Guixols Tortosa Valls Villafranca de Penedès Vitoria Saragossa
Opening date	April
Type of facility	automated underground container storage system
Number of units in station	23, 46, 69, or 92
Users	general public
User fees	free day parking in most cases varying fees for longer parking durations
Capital cost (total)	€175,000 – €246,000 ($241,000 – $331,000)
Capital cost (per space)	€2,400 – €8,500 ($3,300 – $11,700)
Operating costs (total)	up to €6,000 ($8,300) per year
Operating costs (per space)	up to €260 ($350) per year

6.5.2 Overview

The *Biceberg* is a fully automated long-term bicycle parking system. Just as only a small fraction of an iceberg is visible above the water's surface, only a small portion of a *Biceberg* bicycle parking facility is visible above ground. All that can be seen is a small kiosk, roughly the size of a bus shelter where bicycles are dropped and retrieved and where transactions are handled. Below ground, there is a large vault where 23, 46, 69, or 92 bicycles can be stored, depending on the *Biceberg* model.

Users can deposit their bicycles at a *Biceberg* station by swiping a credit card, a bank card, or special electronic key card at the kiosk. An empty container is automatically raised from the underground vault and a door slides open, allowing the user to roll the bicycle into the container. Other items, such as helmets, bags, and other personal belongings can also be placed in the container. The container is then automatically lowered into the underground vault. When the user returns to retrieve the bicycle and other belongings, the card is swiped and the same container is retrieved from the vault and raised back into the kiosk.

Figure 39 - Bicycle being deposited in a *Biceberg* kiosk

Photo: ma-SISTEMAS, s.l.

6.5.3 Location and Context

Biceberg stations have been installed in a number of Spanish communities, including Zaragoza, Huesca, Blanes, and Vitoria as well as in Barcelona. They are generally located in town centres or near major public transportation nodes. In Barcelona, a *Biceberg* station has been installed at Paseo Garcia Faria, a busy commercial street near the City's waterfront. Another station is located just outside of Barcelona proper, on the campus of the Universitat Autònoma De Barcelona (Barcelona Autonomous University).

The historic centres of most towns and cities in Spain are extremely dense. Population densities are far in excess of those found anywhere in Canada. Open space is generally very limited and land values are extremely high. In this context, a space-saving bicycle parking system with a minimal footprint at grade becomes desirable.

6.5.4 Stakeholders

In most cases, the stakeholders in *Biceberg* systems are the builder and operator, a company called ma-SISTEMAS, a municipality, or another public agency. For example, the *Biceberg* facility at Paseo García Faria in Barcelona was developed in collaboration with the City of Barcelona (*Ajuntament de Barcelona*) and is managed by the City's transportation department (*Barcelona Serveis a la Mobilitat* or B:SM). Another *Biceberg* facility in Barcelona, at the Quatre Camins transit hub, was instead developed and is managed by the collaboration with the Government of Catalonia Railways (*Ferrocarrils Generalitat de Catalunya*). In general, all *Biceberg* systems implemented in Spain are government sponsored. Public funds have covered construction costs and are covering operating costs.

In some cases, partnerships with advertisers have been established to generate revenues that help defray operating costs. Ads are displayed on *Biceberg* kiosks, most of which are in prime public locations.

6.5.5 Planning and Implementation

The maker of *Biceberg*, ma-SISTEMAS, was founded in 1994 with a mandate to build high-tech systems for securely storing bicycles. The *Biceberg* concept was invented and patented the same year. The first *Biceberg* facility was implemented in 2001. Since then, ma-SISTEMAS has worked with a number of local governments, particularly in northeastern Spain, to implement *Biceberg* stations.

6.5.6 Design

Biceberg units consist of a small, cubic aboveground kiosk, through which bicycles are deposited and retrieved and user transactions are managed, and a large, cylindrical underground vault in which bicycles are stored (**Error! Reference source not found.**). The kiosks have the same dimensions regardless of the unit's capacity. A vault can contain between one and four stacked carousels, each of which is made up of 23 wedge-shaped containers that hold one bicycle. *Biceberg* units therefore have capacities of either 23, 46, 69, or 92 units. The underground vaults are 7.5 metres in diameter and 1.5 metres to 5.25 metres deep, depending on the capacity of the unit.

Figure 40 - Mockup of a 92 space *Biceberg* unit

Photo: ma-SISTEMAS, s.l.

The *Biceberg* vault is designed to be installed either in an existing underground car parking garage or in purpose-built underground chambers. If installed in a garage, ma-SISTEMAS claims that a 92-bicycle vault has the same footprint as 4 automobile parking spaces.

An electronically controlled lift system extracts a wedge shaped container from the carousel and raises it into the kiosk in order for a bicycle to be deposited or retrieved. Bicycles are loaded into the containers rear wheel first so that the handlebars end up at the wider front end of the container. There is sufficient space with the containers for stowing other belongings, such helmets and bags.

6.5.7 Operations and Services

Biceberg facilities are fully-automated and unstaffed, without exception. The facilities are remotely monitored. Technicians are dispatched to a particular *Biceberg* facility if any software or hardware faults are detected.

In principal, they can operate 24 hours a day, seven days a week. In practice, many of municipalities that have *Biceberg* facilities restrict use of the facilities at night. For example, the *Biceberg* at the Autonomous University of Barcelona shuts down between 6:00 am and 11:30 pm. Users swipe their credit card, bankcard, or a membership card issued by their municipality to deposit their bicycles. In order to retrieve their bicycles, they must once again swipe the same card in order to indentify themselves.

Biceberg facilities exclusively offer bicycle parking and equipment storage. No other services are directly offered.

6.5.8 User Fees

Most *Biceberg* facilities are open to the general public and free to use for a limited period of time. Usually, the maximum allowed parking time is 12 hours (e.g., Vitoria) or 24 hours (e.g., Saragossa). After that, penalties or per hour charges are assessed. Some communities have however opted for time dependent charge for usage of the facility. For example, in Huesca, the fee for use of the *Biceberg* is €0.03 for every 15 minutes.

6.5.9 Costs

The list prices for *Biceberg* hardware are as follows:

- 23 spaces: €115,000 ($157,000)
- 46 spaces: €130,000 ($178,000)
- 69 spaces: €148,000 ($203,000)
- 92 spaces: €166,000 ($257,000)

In addition to the hardware, *Biceberg* facilities implemented thus far in Spain have required a further €60,000 to €80,000 ($82,000 to $110,000) in on-site engineering and construction costs to be installed. This means that per bicycle parking space, the total capital costs would range as follows:

- 23 spaces: €7,600 to €8,500 ($10,400 to $11,700) per bicycle space
- 46 spaces: €4,100 to €4,600 ($5,600 to $6,300) per bicycle space
- 69 spaces: €3,000 to €3,300 ($4,100 to $4,500) per bicycle space
- 92 spaces: €2,400 to €2,600 ($3,300 to $3,600) per bicycle space

According to the manufacturer, total operating costs for a *Biceberg* unit, regardless of size, are around €6,000 ($8,200) per year.

6.5.10 Outcomes

Several *Biceberg* systems have been implemented in Spain, particularly in communities in the relatively wealthy northeastern part of the country (Catalonia, Aragon, and the Basque Country). To date, however, none have been sold abroad, perhaps due in part to the high price tag.

The maker of *Biceberg*, ma-SISTEMAS, s.l., has teamed up with another company, Undercover, s.l., to develop a less expensive derivative of the *Biceberg*. The new product, called the *Bigloo*, is essentially an aboveground *Biceberg*, consisting of a single carousel with 24 bicycle containers housed in an igloo-shaped structure at grade (Figure 41 and Figure 42). Being at grade, the *Bigloo* eliminates the robotic lift system required to move the bicycle containers from an underground vault to an aboveground kiosk. The system is self-contained and portable; no heavy construction is required for its installation, as with *Biceberg*. A *Bigloo* can simply be placed on any level surface and connect to electric power mains. Without the robotic lift system and the heavy construction, *Bigloos* are considerably less expensive than *Bicebergs*. The 24 bicycle *Bigloo* hardware list price is €52,000 ($72,000) versus €115,000 ($158,000) plus €60,000 to €80,000 ($82,000 to $109,000) in on-site construction costs for a 23 bicycle *Biceberg*.[6] The manufacturer claims that operating costs of the *Bigloo* are also lower than that of a comparably sized *Biceberg* by as much as 50%. The disadvantages of the *Bigloo* relative to the *Biceberg* include its much larger footprint at grade and its limited capacity—i.e., only 24 bicycles.

Figure 41 - *Bigloo* prototype

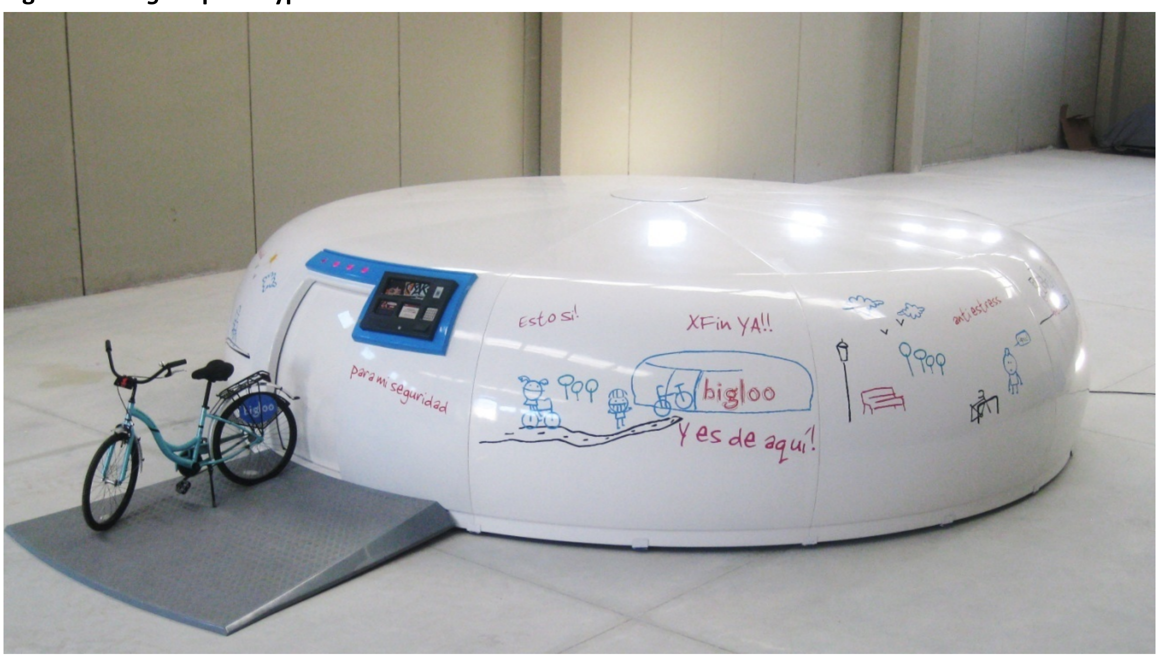

Photo: UNDERCOVER, s.l.

[6] *Bigloo* costs €3,000 ($4,100) per bicycle parking space. It is worth noting that although it is cheaper per bicycle than the smaller (23 unit) *Biceberg*, it is more expensive per bicycle than a 92 unit *Biceberg*, which is estimated to have a total capital cost between €2,400 to €2,600 ($3,300 to $3,600) per bicycle parking space.

Figure 42 - Inside *Bigloo*

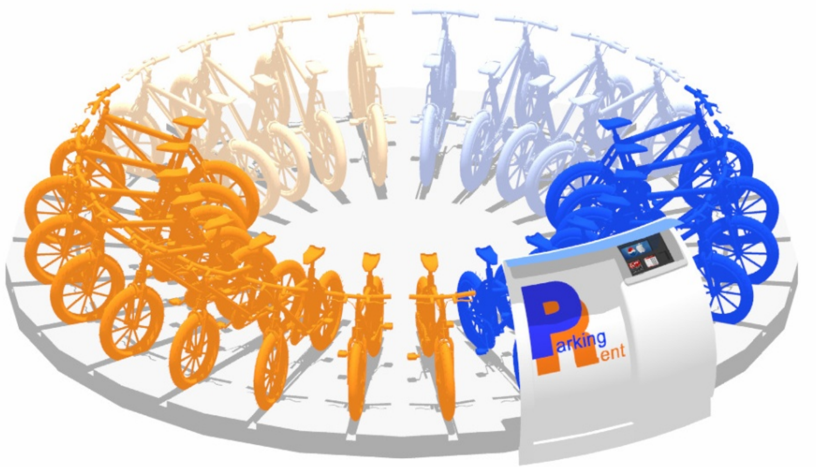

Photo: UNDERCOVER, s.l.

6.5.11 Next Steps

The manufacturers of *Biceberg* and *Bigloo* are actively marketing the two systems abroad, particularly in other European countries and in Latin America. They hope to sell systems outside Spain in the near future. There are currently no plans to market either product in North America.

There is also a pilot project underway to develop an automated bicycle rental system based on the *Bigloo*. Instead of paying to leave their own bicycle inside the *Bigloo*, users would instead pay to take out a rental bicycle and later return to the same or possibly another *Bigloo* with free spaces. In the later case, a set of *Bigloo* stations could in effect be used as the basis for an automated bicycle sharing program.

6.5.12 Sources

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