



# PEDALING FORWARD ON BIKE SHARE DESIGN

## A DESIGN GUIDE FOR BEST PRACTICES IN FLEET BIKE CREATION

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A collaboration of Gates Carbon Drive,  
Dave Weiner of Priority Bicycles, Todd Hoffman  
of Mobia Bikes, and the staff of Gotcha Bike

### INTRODUCTION

As bike share programs and fleet bikes proliferate in communities and at businesses worldwide, one of the most important aspects of a successful program is often overlooked: the creation of a durable, low-maintenance bicycle that minimizes costly maintenance and maximizes time on the road between servicing.





Bike design, too often, is an afterthought, not a first-order priority. While bike share fleets often employ sophisticated software, the bikes themselves and the components used on them are often basic and unreliable. This has consequences for the profitability and consumer satisfaction of the bike share program.

In this paper, we make the case for implementing best practices in bike share design. A well-designed bike will have lower maintenance costs, fewer logistical challenges, better ROI, more public satisfaction and consumer confidence. Choosing the right components can extend the time between mechanical overhauls and reduce labor and replacement costs. That does not mean the most expensive part is the right one. On the contrary, the science and art of designing a fleet bike is about choosing the right part within an overall budget, and knowing where and when it is worth spending more versus less.

Gates Corporation, maker of the Gates Carbon Drive belt system for bicycles, prepared this document based on extensive research of existing bike share fleets and with input from multiple bike share creators.

## **FLEET MAINTENANCE**

Fleet maintenance is one of the largest budget items in a share bike program. Creating bikes and specifying components that minimize maintenance is of paramount consideration. All components have recommended service intervals. These service intervals should be calculated when considering the bike design, replacement part costs, and service maintenance. In addition, the local environment will affect fleet maintenance and influence component and materials choices. Is the local terrain hilly or flat, or near the beach where sand and corrosion will be a factor? How many miles a day do you expect each bicycle to complete? Understanding the service intervals and replacement timelines of every component, and ensuring that replacement parts are easily sourced, is crucial. Downtime is expensive. You want every bike working as many days as possible. A survey of bike share fleets in Seattle found that of a random sampling of 141 share bikes tested by journalists just 68.5 percent were rideable, with the remainder unusable due to maintenance issues and other problems.

## **EQUIPMENT DESIGN CONSIDERATIONS AND FRAME MATERIALS**

Below are important guidelines to keep in mind when considering the numerous choices of components and various materials available in the market. These guidelines are based on market research and conversations with bike fleet operators.



### **Steel:**

- Pros: Inexpensive, strong
- Cons: Heavy, rusts easily

### **Chromoly:**

- Pros: Lighter than traditional steel, strong, will bend under duress
- Cons: More expensive than traditional steel and aluminum, rusts

### **Aluminum:**

- Pros: Inexpensive, strong, light, rust-free
- Cons: Will break under duress, tendency to fatigue

## **DRIVE TRAIN**

For over one hundred years, bicycles have been powered with chains. With modern advancements, and the need for increased durability, new options should be considered.

### **Belt drives:**

- No rust, no grease, lower maintenance and life cycle cost, longer life (2 to 3 X chain), more durable.
- Initial investment costs may be higher but cost of ownership is typically less over the life of the fleet.
- Gates Carbon Drive meets all industry and quality standards and is ISO certified. The 11 mm tooth profile is optimized for bicycles, unlike other belt drive systems that use a standard off-the-shelf 8 mm industrial belt, which will require higher tension.
- Gates Carbon Drive's patented CenterTrack sprocket design is likewise optimized for bicycles.
- When considering other belt drive systems, check that they meet the same industry standards and regulatory requirements as Gates Carbon Drive.

### **Chain Drives:**

- Low cost chain drives will rust and require lubrication.
- All chain drives will need cleaning, re-tensioning, and eventual replacement.

### Shaft Drives:

- Provides a sealed system, but are expensive, heavy and with a reduced gear range and lower efficiency.

### SHIFTING

The simplest design is a single speed bike. These can work well in flat environments, but in hilly terrain they are inadequate. There are multiple options for shifting:

- **Derailleurs** are common on personal bikes due to their low cost, but on a share bike they are susceptible to damage and must be tuned frequently to shift properly. In addition, a derailleur cannot be used with a belt.
- **Internally Geared Hubs**, or IGH systems, such as those made by Shimano, Sturmey-Archer and NuVinci (enviolo) provide an advantage over the traditional cassette/derailleur model because they are sealed from the elements. This means they are lower maintenance. However, depending on the model, many IGH hubs do not allow shifting during hard pedaling, requiring a rider to pause when shifting.
- **CVT, or Continuously Variable Transmissions**, made by NuVinci/enviolo, can be shifted under load and they offer an infinite gear range between the high and the low end of the gear range. They often require less maintenance than a traditional IGH with set gears. However, they are typically heavier and more expensive.



### EBIKE

Electric bikes are increasingly being used in bike share fleets due to their “pedal assist” that amplifies a rider’s pedaling effort. They deliver a higher level of performance, especially in hilly environments, though their system complexity and the need to charge and replace batteries and electronic components adds a level of work and requires an added level know-how for fleet operators. When considering an eBike model, work extensively with the battery and motor suppliers to understand their maintenance schedules and life expectancies. Can the electric systems and batteries be serviced in-house or will they need to be shipped to the manufacturer? Due to their battery packs and motors, eBikes are heavier. This places extra demands on workers when lifting eBikes into trucks for transport, and they may require special work stands for mechanics.



## BRAKES

**Rim Brakes:** There are two types, caliper and linear pull. Both are relatively inexpensive and easy to source. However, they can provide a poor rider experience anytime the bicycle wheels are warped or not true, causing the brake pads to rub on the rims. Caliper brakes require frequent pad changes. **Linear pull rim brakes offer increased stopping power compared to caliper rim brakes.**

**Drum Brakes:** Drum brakes are a frequent choice for fleet bikes as they work well in inclement weather and are not dependent on the rim being true. A quality drum brake will be more expensive than rim brakes, though this cost can be offset by their low maintenance and performance in the rain.

**Disc Brakes:** While they are the choice of many high-performance bicycles, offering excellent all-weather stopping power, they are infrequently used on share bikes because the rotors can easily be bent or warped if banged. This can require significant maintenance or replacement costs.

**Coaster:** A rear coaster (foot) brake provides excellent all weather stopping power with low maintenance. However not all riders are comfortable using coaster brakes. In addition, they should be combined with a front hand brake for safety reasons, such as a chain snapping.

## SADDLES

Kevlar saddles, such as the ones used by Gotcha Bike Share, offer improved wear resistance and durability. Bike share operators should likewise avoid saddles with stitching on the top side, as these can become saturated in rainy environments. Saddles with center cut-outs often fair better by allowing water to flow through.

## TIRES

Flat tires are one of the largest maintenance issues for bike share operators. Flat tires can leave riders stranded, lowering public satisfaction in the share program, and replacing flats requires manpower and expense. This has led to the rise of “no-flat” or “flat-free” tire technologies including liners, liquid tire additives, and solid tires which require no air. Mobia exclusively uses Titec flat free tire systems on all their bikes. Make sure all installation, removal, and maintenance of ‘flat free’ technologies is understood ahead of time. Tires should also incorporate reflective sides for safety.



## **WHEELS**

Spokes are the backbone of a wheel, ensuring they remain true. Using higher quality stainless steel and thicker gauge spokes can prevent breaks and the need for wheel rebuilds. Mobia uses 12 gauge spokes. This heavier spoke builds a stronger wheel. Some bike share designs skip spokes altogether by using cast aluminum wheels. These offer increased durability but are heavier.

## **KICKSTANDS**

A wide stance kickstand (preferably two-legged) better supports the bicycle on uneven pavement, preventing damage due to falling over.

## **SAFETY**

All fleet bikes should comply with country and industry regulations. For bicycles in the USA, this means CPSC testing. For bicycles in Europe it means EN, ISO, or CE testing. For US companies we also recommend EN/ISO testing as its requirements are more strenuous. Lastly, all bikes should have an information label with emergency calling information.

## **REFERENCE MATERIAL AND LINKS CAN BE FOUND AT**

[GatesCarbonDrive.com/products/bike-share](https://GatesCarbonDrive.com/products/bike-share)