

GNG2101

## **Design Project User and Product Manual**

### **Group A3.3 Accessibike**

Submitted by:

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# List of Acronyms and Glossary

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**Table 1. Acronyms**

| Acronym | Definition            |
|---------|-----------------------|
| CAD     | Computer-aided design |
| BOM     | Bill of Material      |

# **1 Introduction**

This User and Product Manual (UPM) provides the information necessary for the wheelchair user and the assistant who is loading and pushing the carriage to use Accessibike effectively and for prototype documentation. It is important to read through this manual before use to ensure all operations are completed properly and that both the person in the wheelchair and the person on the bike are safe.

## 2 Overview

Riding a bicycle is a rewarding experience that, unfortunately, not everyone can enjoy. Our product aims to help people with physical limitations enjoy all the benefits of riding a bicycle without having to worry about riding the bike itself. The user of our product would want something that is safe, easy to use, and durable. Our product would allow someone with physical limitations to enjoy the experience of riding a bicycle while not worrying about riding the bicycle itself.



*Figure 1: Our product, Acessibike*

To use our product, the user simply rolls onto the platform and gets secured with straps. The aide attaches the platform to the bicycle and secures it, and they are good to go. The prototype is made from hollow steel tubing, wooden platforms and bicycle wheels. The final product is made from hollow steel tubing, a steel platform and two high-quality wheels. The product is designed to be used on light terrain for cycling, mainly focusing on trails with minimal obstacles due to the size of the product.

## **2.1 Conventions**

**Ensure** means to check condition(s) or make certain that (something) shall occur.

**Do not/don't** mean not to do.

## **2.2 Cautions & Warnings**

Cautions and Warnings:

- Do not operate when under the influence of drugs or alcohol
- Ensure that all straps are secured before usage
- Ensure that the attachment to the bicycle is secure before usage
- Ensure that breaks are in working order
- Do not allow persons under 18 to operate the product

### 3 Getting started

1. Remove the front wheel on the bike of choice
2. Take the bottom of the fork without the axle and put it over the axle in the fork mount attached to the carriage.
3. Attach a u-bolt around the top of the bike's frame and secure nuts to the back plating to hold the top mount for the carriage (see the image below).



*Figure 2: Step 3 instructional image reference*

4. Load the wheelchair onto the platform and use the tie-downs to secure the wheelchair in place.



### **3.1 Configuration Considerations.**

Works with any type of mechanical wheelchair that can fit in the carriage. Any adult bike can be used, including mount or road bikes.

### **3.2 User Access Considerations**

This product is for any user in any type of wheelchair to experience the joy of biking. The user may be physically impaired or unable to bike. The other user is the one who pushes the carriage on a bike. This user can be any helper or assistant to the wheelchair user, who will be strapping the wheelchair to the platform and checking the attachments.

### **3.3 Accessing/setting up the System**

Ensure the tires on the carriage are full of air and properly secured by tightening the quick release. Remove the regular bike's front wheel and attach the bike fork's bottom to the black fork mount on the carriage. Connect the u-bolt around the bike's frame and fasten the nuts tightly. Finally, ensure everything is stable and connected securely.

### **3.4 System Organization & Navigation**

All steel tubes are welded together, and the rest of the components are fastened with bolts and nuts. All components are mechanical, including the brakes. Therefore there are no batteries or electronics that may malfunction. The two wheels for the carriage are attached right to the frame,

so it is very sturdy. The bike attachment had a square tube on the end, which goes over the round tube on the carriage allowing the bike to turn while pushing the carriage.



*Figure 3: Bike and Carriage Attachment*

### **3.5 Exiting the System**

When dismounting the product, ensure that all straps are released before dismounting the client. Ensure that all removable parts and components are stored safely for future usage and maintenance. Store the product in a cool, dry place.

## **4 Using the System**

We at Accessibike, take pride in our product's ease of use and safety. The main systems of the product that are used are the mounting mechanism to the bike's frame, the fork attachment located on the rear of the product, and the tie-down system for the wheelchair. Together, the mounting systems are used to secure the device strongly and safely.

The following subsections provide detailed, step-by-step instructions on how to use the various functions or features of the Accessibike.

## **4.1 Mounting to a Bike**

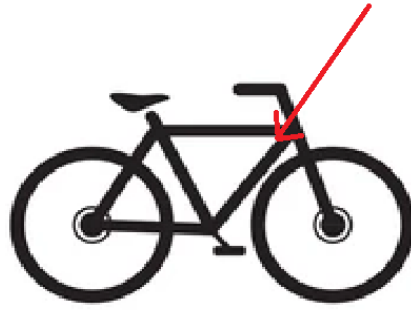
The process of mounting the product to a bike is straightforward and can be completed in a few easy steps. The first step is to connect the bike's fork to the product, and the second is attaching the support member to the bike and fitting it onto the product.

### **4.1.1 Fork Mounting**

In order to mount the bike's fork to the product, you must first remove your bike's front wheel. Once removed, the fork can quickly settle onto the adjustable fork mounting system on the two vertical support members at the back of the product. Once it is in place, tighten the adjustable fork mounting system to secure it in place.

### **4.1.2 Attaching the Support Member**

The support member fixed to the bike's frame allows for proper support and a safe connection to the product. To use the support member, first slip the U-bolt around the triangular part of your bike's frame, ensuring the threaded portion of the bolt is facing forwards.



*Figure 4: Location to slip U-bolt onto*

Then, align the holes on the flat plate of the support member to the U-bolt threads and tighten the nuts by hand until snug. Tighten the nuts further with a standard  $\frac{3}{8}$ " wrench. Once tight, slip the hollow tube attached to the support member over the vertical support tube on the product.

## **4.2 Securing the Wheelchair**

It is important to properly secure the wheelchair onto the platform to ensure the safety of the rider and the user of the bike. First, loosen the nuts on the support member to allow the platform to tilt down and form a ramp. Second, roll the wheelchair onto the platform until it is almost at the back. Once in place, use at least three ratcheting straps attached from the edge of the bottom of the frame to the mounting points on the wheelchair. Place the wheel chocks in front and behind the wheels of the wheelchair and ensure all the straps are tight.

## **5 Troubleshooting & Support**

Ensure tires are not flat, ensure nuts and bolts are on the thigh and ensure the bike attachment is secure and not loose. Test breaks on the bike's rear wheel and both wheels on the carriage to ensure the breaking is working correctly.

### **5.1 Problems That May Come up**

If the steering is not working properly, check the fork and frame connection; if the ride is not smooth, check the tires for leaks. Check for cracks and breaks in the frame if something feels wrong. The top bike mounting may bend or break over a long period of time, before riding, making sure there are no brake problems.

### **5.2 Special Consbreakions**

The maximum load for the product is 150 KG. Please do not exceed the weight limit to ensure user safety. Do not take on steep hills of 15° or more. Stay on a smooth surface without any large rocks or roots.

### **5.3 Maintenance**

Ensure the air pressure in the tires is acceptable to ensure the product's best performance and the users' safety. And sure, the bike being used to push the carriage has air in the back tire, chain lubricated and other recommended maintenance by the manufacturer.

## 5.4 Support

Any issues can be resolved by contacting Josh at [jlaro121@uottawa.ca](mailto:jlaro121@uottawa.ca) with the problem and what has been tried so far.

## 6 Product Documentation

During the development of our final product, many considerations were made throughout the building process. We needed to consider how to connect the tubes. We did but half-mooning the tube to overlap the other tube to be welded together. This is the strongest and safest method to connect pipes. Another consideration was attaching the wheels to the carriage, and we decided to use the wheel mount from an old bike cut and then weld them onto our carriage. That way, we can measure the width of each side for both wheels. One final consideration made was how to connect the bike to the carriage. We had a few different ideas that could work. We chose the simple design because of restraints on time. Our solution worked well, but we would have liked the starter earlier to increase, which our future plan will fix. We chose to use 1-inch thin steel wall tube because it was cheaper than aluminum and for its ability to be kept outside year-round. We decided to use the mounting for the bottom of the bike fork as it can work with any bike to attach to the bottom of the carriage, as seen in the image below.



*Figure 5: Bike fork attachment*



*Figure 6: Demonstrations on face Constraints*

## 6.1 Frame of Carriage

### 6.1.1 BOM (Bill of Materials)

| Item            | Quantity | Need                                                                   | Cost \$                                                       | Link                                                                                                                                                                                                                                                                                                  |
|-----------------|----------|------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame structure | 30 feet  | Steel tubing, to build the frame of the carriage<br><br>Including cuts | \$141.97<br>With tax                                          | <a href="https://quote.metalpros.com/?search=&amp;shape=PIPE%2F%20TUBE%2F%20MECHANICAL&amp;size=1.000x0.870x0.065&amp;material=COLD%20ROLLED%20STEEL">https://quote.metalpros.com/?search=&amp;shape=PIPE%2F%20TUBE%2F%20MECHANICAL&amp;size=1.000x0.870x0.065&amp;material=COLD%20ROLLED%20STEEL</a> |
| Bolts           | 5        | For holding materials together<br>(provided from maker store)          | \$6.24<br><br>free                                            | <a href="https://www.homedepot.com/p/Everbilt-3-8-in-16-x-1-in-Zinc-Plated-Hex-Bolt-25-Pack-800820-The-Home-Depot-!">Everbilt 3/8 in.-16 x 1 in. Zinc Plated Hex Bolt (25-Pack) 800820 - The Home Depot !</a>                                                                                         |
| Nuts            | 5        | $\frac{3}{8}$ 16                                                       | (3)\$0.84<br><br>=.95 with tax<br><br>2 provided by maker lab | <a href="https://www.homedepot.com/p/3-8-in-16-tpi-Zinc-Plated-Hex-Nut-2-per-Pack-816458/204274081">https://www.homedepot.com/p/3-8-in-16-tpi-Zinc-Plated-Hex-Nut-2-per-Pack-816458/204274081</a>                                                                                                     |
| nuts            | 2        | $\frac{1}{4}$ 28                                                       | 0.30<br><br>=.34 with tax                                     | <a href="https://www.homedepot.com/p/Everbilt-1-4-in-28-Zinc-Plated-Hex-Nut-801826/204647897">https://www.homedepot.com/p/Everbilt-1-4-in-28-Zinc-Plated-Hex-Nut-801826/204647897</a>                                                                                                                 |



|                               |                             |                                                  |                                    |                                                                                                                                                                                                                                                                                               |
|-------------------------------|-----------------------------|--------------------------------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>U-bolt</b>                 | 1                           | To connect the bike to carriage                  | 3.79<br>=4.28<br>with tax          | <a href="https://www.canadiantire.ca/en/pdp/hillman-zinc-plated-u-bolt-with-nuts-0611952p.html?loc=plp">https://www.canadiantire.ca/en/pdp/hillman-zinc-plated-u-bolt-with-nuts-0611952p.html?loc=plp</a>                                                                                     |
| Flat washers                  | 12                          |                                                  | \$1.20<br>Free for<br>maker<br>lab | <a href="https://edu-makerlab.odoo.com/shop/product/flat-washers-74#attr=480">https://edu-makerlab.odoo.com/shop/product/flat-washers-74#attr=480</a>                                                                                                                                         |
| <b>Bottom Fork attachment</b> | 1                           | To attach the bottom of the fork to the platform | \$31<br>=35.02<br>with tax         | <a href="https://www.amazon.ca/gp/product/B000QJC5F8/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&amp;psc=1">https://www.amazon.ca/gp/product/B000QJC5F8/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&amp;psc=1</a>                                                                               |
| Top bike attachment metal     | 1x1ft <sup>2</sup><br>16 GA |                                                  | \$5<br>Free                        | Form Alex at MTC                                                                                                                                                                                                                                                                              |
| small steel rectangles        | 8                           | For varus connections and to hold the platform   | free                               |                                                                                                                                                                                                                                                                                               |
| Other scrap metal             | 2                           | 1.5' square tubing                               | free                               | From MTC                                                                                                                                                                                                                                                                                      |
| <b>Spray paint</b>            | 1 can                       | To conform to the client's colour request        | \$11.99<br>=13.55<br>with tax      | <a href="https://www.canadiantire.ca/en/pdp/premier-interior-exterior-multi-surface-aerosol-spray-paint-primer-gloss-340-g-0482400p.html?loc=plp">https://www.canadiantire.ca/en/pdp/premier-interior-exterior-multi-surface-aerosol-spray-paint-primer-gloss-340-g-0482400p.html?loc=plp</a> |

|                   |  |  |                       |                             |
|-------------------|--|--|-----------------------|-----------------------------|
| New total<br>cost |  |  | =\$196.11<br>with tax | Cost of everything I bought |
|-------------------|--|--|-----------------------|-----------------------------|

### 6.1.2 Equipment list

Used bike for parts, both wheels, axles, and wheel mounts

30 feet of 1 inch thin wall steel tubing

### 6.1.3 Instructions

1. Disassemble a bicycle to use its components (steel tubing, wheels, axles, wheel mounts)
2. Use steel tubing to assemble the skeleton structure of ACESSIBIKE
3. Attach wheels salvaged from bicycle to either side of skeleton of ACESSIBIKE
4. Attach fork attachment
5. Attach U-bolt attachment
6. Attach platform to skeleton structure
7. Attach straps to the platform

## 6.2 Testing & Validation

Tested the weight capacity on the carriage to figure out what the maximum weight capacity would be; we found it to be 150 kg, including wheelchair and person. We also tested the

steering angle when the bike is attached to make sure it can navigate Ottawas's paths, and we would like to work and improve the steering range. We also tested the bike support stretch, which we found to be much stronger than expected, supporting maximum force from a rider pushing down.

## **7 Conclusions and Recommendations for Future Work**

During the time working on this project, we have learned many lessons about working as a team, designing, manufacturing, and building. When developing a design for our product, we each designed a few different ideas and showed them off to decide which one was the most feasible. We easily agreed on the solution when we began a detailed design concept to understand further how we would build our product. Many challenges were faced while building our product, some of which included certain design choices to have maximum strength. We needed to help develop ideas for mounting the bike to the carriage so it could fully turn. We also realized we could have begun on our prototype much earlier as it took a lot of time to build and manufacture a product of such a size. We wish we had started the manufacturing sooner as it would have given us more time to add more features we designed, such as wiring the brakes and adding small battery power lights. For future work, we would like to see a ramp added on the front with a locking so that when in movement, the client's helper can quickly put the wheelchair on the carriage's platform. Another thing we wish to complete is an improved steering angle, so it is easier to operate on narrow paths.

## 8 Bibliography

Clients wheelchair: <https://www.kimobility.com/Product.action?productName=Focus+CR>

## APPENDICES

### 9 APPENDIX I: Design Files

This document provides a summary of each of our deliverables combined; for more detailed information related to the deliverables, please refer to our Makerrepo page. Every document will be found there.

Makerrepo link:

<https://makerepo.com/joshers/1280.accessibike>

**Table 3. Referenced Documents**

| Document Name    | Document Location and/or URL                                                                                                                                                                                                                                  | Issuance Date  |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Deliverables A-J | <a href="https://makerepo.com/joshers/1280.accessibike">https://makerepo.com/joshers/1280.accessibike</a>                                                                                                                                                     | Dec 11th, 2022 |
| 3D model         | <a href="#">3D_Model.STEP</a>                                                                                                                                                                                                                                 | Nov 15th, 2022 |
| Photos           | <a href="https://makerepo.com/joshers/1280.accessibike">https://makerepo.com/joshers/1280.accessibike</a>                                                                                                                                                     | Dec 11th, 2022 |
| Wrike Gant Chart | <a href="https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=UFkNUf22bnWfrQ0t6hIMK4xTC413e6Ea%7CIE2DSNZVHA2DELSTGIYA">https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=UFkNUf22bnWfrQ0t6hIMK4xTC413e6Ea%7CIE2DSNZVHA2DELSTGIYA</a> | Dec 11th, 2022 |