This appendix is intended to organize the overall design thought process, including what level of design should be included in this project for each component.

### P-1 Sub-Assemblies

The following list includes the major sub-assemblies of the TrailRider. The bolded list is what our group chose to focus on given the time constraints of the project.

* Frame
  + Overall dimensions
  + Material
  + Cross sectional area
  + Footplate
* Seat
  + Seatbelt
  + Cushion
  + Seat angle positioning
* **Drive system**
  + **Chain drive vs. Gearbox**
  + **Chain (if used)**
  + **Levers**
  + **Gears / sprockets**
  + **Axle**
* Sherpa handlebars
  + Hand grip
  + Overall shape and ergonomics
* Braking System
  + Disc rotors
  + Pads
  + Cables and housing
  + Lever braking pins
* Wheels
  + Castor wheel
  + Two main wheels
  + Diameter/Width
  + Pressure
  + Tread type

#### P-1.1 Frame

**Design Decision: Frame material**

Use whatever the trailrider or other wheelchairs use

#### P-1.2 Seat

**Design Decision: Seat width**

Decision - 17”

Calculated based on average width from GRIT chair seat width options

<https://www.gogrit.us/grit-freedom-chair-3-model>

#### P-1.3 Drive System

**Design Decision: Train value**

*Decision - e = 0.71*

Table 1: Pros and cons of using a higher train value (decreased torque increased speed)

|  |  |
| --- | --- |
| Pros | Cons |
| Easier to start from rest | Lower maximum speed |

Design Trailrider average speed: **4.4 km/hr**

Calculations are shown below:

From "How long is a hike" from "BCMOS Background" for Garibaldi: 12 hours, presumably an acceptable speed.

From <https://www.vancouvertrails.com/trails/garibaldi-lake/>: 5 hours

We can say that ratio of BCMOS hike time per regular hike time: 12/5

Speed ratio would be the inverse: 5/12

Regular trail speed around Stanley Park speed from <https://www.vancouvertrails.com/trails/stanley-park/>: 6.5km/2hr

Acceptable BCMOS trail speed: (6500m/7200s)(5/12) = 1.354 km/hr

However, since we aim for higher speeds, a reasonable speed to choose is 4.4 km/r based on our train value of 0.71.

**Design Decision: Power transmission method**

*Decision - Chain Drive*

In table 2, the most important advantages and disadvantages are highlighted in bold.

Table 2: Gears vs chain vs belt pros and cons

|  |  |  |
| --- | --- | --- |
| System | Pros | Cons |
| Gear | High efficiency | **Opposite rotation - requires idler gear to make it work (too many parts)** |
| Velocity ratio remains constant (not important here as speeds are low) | Rigid parts requires precise alignment |
| Good for small to high speed reduction | Requires full lubrication to prolong life |
|  | Short center distance |
| Chain | **Easy maintenance with local bike shops** | Cannot be used for non-parallel shafts |
| Chain introduces flexibility into system | Chordial speed variation (not very important here as speeds are low) |
| Allows for medium center distances |  |
| Belt | Flexibility in the system | Belt slip occurs |
| Quiet operation | Requires pre-tension |
| High efficiency (up to 98%) | Relatively low life |
| No lubrication required | **Easily damaged by heat and abrasives** |

\*\* Incorporate value equation into a design decision

**Design Decision - Rear wheel hub and driving/driven sprocket types**

*Decision -* 14-28T rearcassette and free hub mechanism

*Decision -* Front sprocket with 17 teeth

From our calculations in Appendix F, we determined that we need a driven sprocket with 24 teeth. Since our design requires a free-hub mechanism to use the lever drive, we chose a cassette with multiple cogs because it is an easy part to obtain off the shelf. We will simply use one of the cogs (the 24T one). Combined with a 17 tooth front sprocket, this creates a train value 0.71.

#### P-1.4 Sherpa Handlebars

Due to the time constraints of the project we did not have time to specify sherpa handlebars.

#### P-1.5 Braking System

Due to the time constraints of the project we did not have time to specify the braking system.

#### P-1.6 Wheels

**Design decision: Main wheel diameter**

*Decision - 26”*

Table 3: Pros and cons of using a bigger wheel diameter

|  |  |
| --- | --- |
| Pros | Cons |
| More contact with the ground, so more traction | Harder to accelerate |
| Smoother ride | More expensive |
|  | Heavier |
|  | Raises the COG |

GRIT Freedom chair uses 26” all terrain mountain bike wheels

**Design decision: Main wheel width**

*Decision- 2.3”*

Table 4: Pros and cons of using a wider wheel

|  |  |
| --- | --- |
| Pros | Cons |
| More traction | More rolling resistance |

Sand + snow wheels are 2.3” wide (used on GRIT chair)

**Design decision: Caster wheel diameter**

*Decision - 6”*

Industry Wheelchair Castors range from 3”- 8” (8” seen on GRIT Chair)

<https://www.spinlife.com/en/wheelchairwheelchoices2.cfm>