Alternative Designs Report

Snow/Sand Wheelchair

By

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Team 2

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Alternative Design 1

The Snow/Sand Wheelchair will start with the modification of an existing wheelchair frame. The front axle where the front wheels attach will have to be extended so that the front and back wheels are in side alignment. All four wheels will be modified so that the treads can interlock with wheels so that there is no tread-wheel slip. This will maximize the efficiency and power output by the subject to the wheels and treads. A side view drawing of the design can be found in Figure 1.

Figure 1: Alternative Design 1 – Side-View

Short skis will be attached to the wheelchair’s frame via a manual jack that will be located on the back of the chair. The purpose of this jack is to raise or lower the frame, and wheels/treads, relative to the skis. This will adjust the amount of force on the wheels, making it easy to control how much grip and weight the treads actually have
on the ground. The wheelchair will also be coated with an anti-corrosion treatment to allow for a longer life and more rigorous usage.

A front view of the design can be found in Figure 2.

![Figure 2: Alternative Design 1 – Front-View](image)

The wheelchair will be self-propelled like a normal manual wheelchair. A propulsion wheel will be added on the outside of each of the back wheels which will allow the subject to control his speed and direction. The propulsion wheel will be pushed like a propulsion wheel on a regular manual wheelchair, and the device will steer much like a tank, by having one tread stop and the other tread rotate around it.

This method of propulsion and steering is a major drawback to this type of design, however. Although the wheelchair can easily traverse sand, snow, and ice, the amount of mechanical output that is required to move such a device is massive. A tank can output a lot of mechanical energy due to its massive and powerful motors.
However, when the motors are removed, the energy and force required to move treads along any kind of terrain is fairly large. It is believed that this is a very creative design; however, not entirely practical because a person will most likely not be able to put out as much energy and force as is needed to propel and steer such a device.
Alternative Design 2

The goal of this design is to make the multi-terrain wheelchair as user friendly as possible. Its purpose is to offer the user the ability to manually adjust the wheelchair with minor mechanical knowledge so that it is suitable for a given terrain. In addition, the user is able to attach and detach a previously owned seat which is known to offer the proper support for exceptional comfort. This design is based on the fact that the costumer would like the multi-terrain wheelchair to also function as a sled when desired if possible. The frame consists of stainless steel bars, which are not only light-weight but also durable ensuring years of proud ownership. Figure 3 shows the top-view of the steel frame.

![Figure 3: Alternative Design 2 – Top-View of Steel Frame](image)

Bars 1 and 4 will function as the attachments to either large wheels or skies. Bars 1-4 will all be telescopic allowing for the modification of the width of the multi-terrain wheelchair in order to complement the width of the user owned seat. They will
also give the ability to decrease the width in order to make the wheelchair easier to transport. Bars 7 and 8 are the handle bars of the wheelchair.

Figure 4 shows the side view of the multi-terrain wheelchair frame with wheel connections connected.

Bar 9 is also telescopic giving the user the ability to raise or lower the handlebars in order to allow individuals of varying heights to push the wheelchair with ease and comfort. Bar 10 is used to attach either large wheels or skies to the back of the wheelchair. Bar 11 is actually a caster which holds the front wheel giving it the ability of a 360 degree turn. It can detach from bar 6, and a new bar can be connected to allow the attachment of front skies. In other words, the user will be able to have a 4-wheel multi-terrain wheelchair ideal for sandy or rocky terrains, a hybrid wheelchair with two
front skies and two back wheels ideal for level snowy conditions, or a full ski wheelchair which in reality will function more like a sled than a wheelchair.

When the user wants to convert the multi-terrain wheelchair to a sled, telescopic bars 5 and 6 can be extended forward and bars 1-4 can be extended outward for increased stability. This sled design is currently being evaluated, in order to decide whether additional side safety sleds will be required to prevent the sled from flipping.

Figure 5 shows the front view of the multi-terrain wheelchair in 4 wheel mode.

![Figure 5: Alternative Design 2 – Front View of 4-Wheel Mode](image)

As can be seen in the figure, when the back wheels are attached, the grip rings are located on the inside of the tires due to the width of the back tires. The wheels will
be made of some sort of soft plastic to enable easy transport through tough terrains as well as absorb shock. Three tire variations are currently being investigated; tread-less, thick triangular treads, and thin triangular treads. Figure 6 shows the side view of the multi-terrain wheelchair in 4-wheel mode in order to give a perspective of the proposed size of the tires.

Figure 6: Alternative Design 2 – Side View of 4-Wheel Mode
Alternative Design 3

This design of the multi-terrain wheelchair is a device which can better help Sean propel himself in snow and sand. The way it will help is because he can use his legs to propel himself instead of his arms. This device has pedals for Sean to use just like a bicycle. The pedals will power the back wheels which will be larger in size than bicycle wheels to help the wheelchair gain traction. To control the device Sean will use handlebars which will turn the front wheels left and right. The good thing about having Sean use his feet to propel the device is that the leg muscles are much stronger than the arm muscles. In addition, Sean rides a tricycle at home so he is used to the pedaling motion. This is relevant because in order to increase the traction of the device the wheels need to be larger. Larger wheels will need a larger force to propel them which can be given by Sean’s legs. Also since Sean will be using this device in snowy and icy conditions the device should not move very fast, which means a gear ratio can be implemented to lessen the force needed by the pedals to propel the wheels. Having Sean use his feet can be useful in safety precautions also. A brake can be made for Sean to use with his feet, such as pedaling backwards which is used on many bicycles. As well as having a foot brake Sean can have a hand brake which will give him two ways of controlling the device to a stop.

Another good feature about this design is that it can be pushed like a wheelchair from behind. The pedals can be disconnected for this purpose. Having many options for the user can lead to a good device since the user can use whatever option works best for him at the time.
The basic design will be an ordinary wheelchair which will be modified to be useful for Sean. The rest of the frame will be made of stainless steel which will prevent rust in the snow and at the beach. The chain used will be a normal bicycle chain.

Figure 7: Alternative Design 3 – Top View
Figure 8: Alternative Design 3 – Side-View