

CHAPTER 8
MISSISSIPPI STATE UNIVERSITY

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TRAIL READY UTILITY VEHICLE FOR PEOPLE WITH PHYSICAL DISABILITIES

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INTRODUCTION

The modern All-Terrain Vehicle (ATV) has increased the number of individuals participating in outdoor recreational riding. The ATV is a mainstay for hunters and recreational riders because of its ability to traverse rough, narrow trails. Unfortunately, many individuals with disabilities have limited access to remote areas due to transportation limitations. Some wheelchairs have limited mobility when operated on non-firm surfaces, while others are too heavy and lack the necessary energy reserve to traverse rough trail conditions. To facilitate safe deep-woods access for handicapped individuals, the Trail-Ready Utility Vehicle (TRUV), Figure 8.1, was designed and constructed according to the width of a standard ATV, thus allowing access on narrow trails.

SUMMARY OF IMPACT

Ease of transportation to and from various hunting sites is a principal concern for hunters with disabilities. The Physically Challenged Bowhunters of America organization reports that prior to the opening of the first disabled-only hunting tract in the State of Virginia, handicapped hunters had to be pushed through miles of wooded trails. The special features of the Trail-Ready Utility Vehicle allow individuals with disabilities to enjoy the outdoors.

TECHNICAL DESCRIPTION

A review of present methods of transporting individuals with disabilities to remote wilderness locations, an evaluation of narrow rough access trails, and an examination of the limitations of disabled individuals yielded the objectives for the TRUV. The TRUV is to be safe, low-cost, lightweight, ATV-towable, capable of traveling narrow trails, and tai-

lored to the transportation needs of the individual with disabilities.

The main frame, side supports and side ramp of the TRUV are fabricated from 2-inch and 1-inch square steel tubing. Two ATV tires are positioned at the rear and mounted on rubber torsion axles. This provides optimum floor space, minimum width and weight, ease in entrance and exit, and a low center of gravity. The main frame is constructed of 2-inch square steel tubing with a 1/8-inch wall. This material is also used in the tongue and in the frame supporting the axles. The remaining steel members are 1-inch square tubing with a 1/12-inch wall. These members include staggered ladder bracing in the main frame, vertical side supports, top rail and the ramp framing, and bracing. The original center X-brace in the main frame was replaced with two longitudinal members positioned according to the distance between wheelchair tires. These two members are connected with additional sections of 1-inch square tubing.

With tires in the rear, stiffness of the 500-pound capacity axle system was tested. For load testing, an electric wheelchair was obtained from the T.K. Martin Center at Mississippi State University. With the axles in the rear, the front region near the tongue experiences the most deflection. Unloaded, the front, left corner of the floor frame is positioned 12 inches above the ground. With the new axles hitched to the ATV, deflection was noted with zero load, with a wheelchair centered on the frame floor, and with the wheelchair and a 190-pound person standing at the left, front corner. During motion, the vehicle rides comfortably and adjusts well to challenging ground sur-

faces at the low speed of 15 mph without causing the ATV to become off-balance.

The ramp/door of the TRUV is 64 inches x 47 inches. This provides ease in entering and exiting the TRUV. A 32-inch panel folds down after the innermost panel is pulled up to the side. For additional accessibility or maintenance, the ramp may be removed at anytime. Figure 8.2 shows the frame of the ramp without the top surface.

Two steel plates, mounted behind the box frame, provide points of attachment for wheelchair tie-downs.

The nylon straps, manufactured by Welch Hydraulix Company, are locked into the steel plates.

The TRUV satisfies all performance objectives. The TRUV is 130 inches long, 45 in wide, and stands 46 inches tall. With the addition of the roll cage, side panels, jack, steel fenders, and camouflage covering, the TRUV will be an even more valuable tool for the disabled hunter.

The total construction cost of the TRUV is \$1,253.90.



Figure 8.1. Trail Ready Utility Vehicle (TRUV).



Figure 8.2. TRUV Ramp.

ROLLER WALKER WITH SPRING-ACTIVATED BRAKING SYSTEM FOR A PATIENT WITH CEREBRAL PALSY

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INTRODUCTION

A specialized roller walker was designed for a client with cerebral palsy (Figure 8.4). The individual has more involvement of the right side, causing him to direct most of his weight to the left side of his body. The individual possesses only gross motor skills, but is active and capable of maneuvering a rolling walker. The frame had to be designed to the patient's height, stance width, and stance depth.

SUMMARY OF IMPACT

Individuals with physical conditions affecting their ability to perform the routine tasks of everyday life often use ambulatory assistive devices. Cerebral palsy is an example of a disorder that causes reduced muscle performance, which may require the use of an ambulatory assistive device. Walkers are one type of assistive device used to add gait support by providing a wide base stance and improving stability to anterior and lateral portions of the body. Although walkers are effective, not all individuals with disabilities are able to use standard walkers. Rolling walkers may be more efficient compared to the standard walker for people with limited upper body strength.

TECHNICAL DESCRIPTION

The material used had to be capable of withstanding repeated applications of concentrated force. The wheels had to be able to adapt to common surface frictions, overcome floor obstacles, and withstand typical weather conditions. In addition, the two rear wheels had to be able to withstand the pressure of an applied brake pad. The brake system had to be easy to engage with small amounts of force. Finally, it was

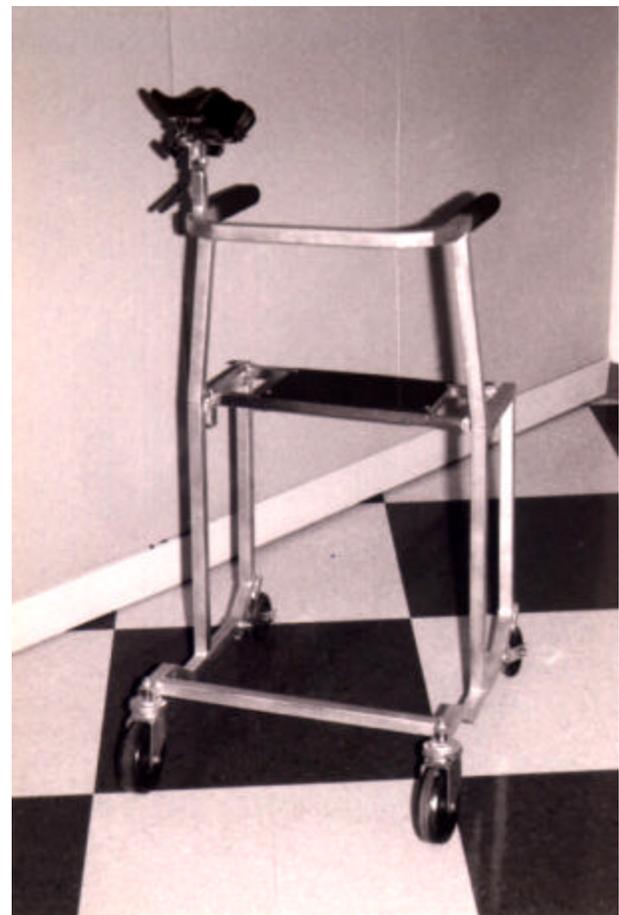


Figure 8.3. Roller Walker.

important that the brake stop the rolling wheel effectively without causing damage to the mechanism.

The walker has three main components: the frame, the wheels, and the braking system. An arm piece and a seat were added to the frame for comfort. The frame is

a solid rectangular structure consisting of 1" ASTM A36 structural steel with welded joints. The walker stands 31" high, 21" wide, and 22" deep (Figure 8.3). On the right hand bar is an arm support located 3" from the front of the structure. An adjustable seat suspended from the left side of the walker can be retracted across the walker.

The front wheels are made of a hard synthetic rubber with a diameter of 5" and a tread width of 1.5". The rear wheels have a diameter of 4" and tread width of 1". The wheels are made of neoprene rubber and were obtained from the Darcor Company in Ontario, Canada.

The braking mechanism is a push-down spring-activated system. A solid steel block with dimensions of 2.25" x 1.25" x .75" was welded to the base of the frame. A spring located in a plane perpendicular to the brake pad allowed for the brake action. When a force is applied to the frame, the spring compresses and engages the brake.

The welded frame provides adequate support and the braking system operates effectively.

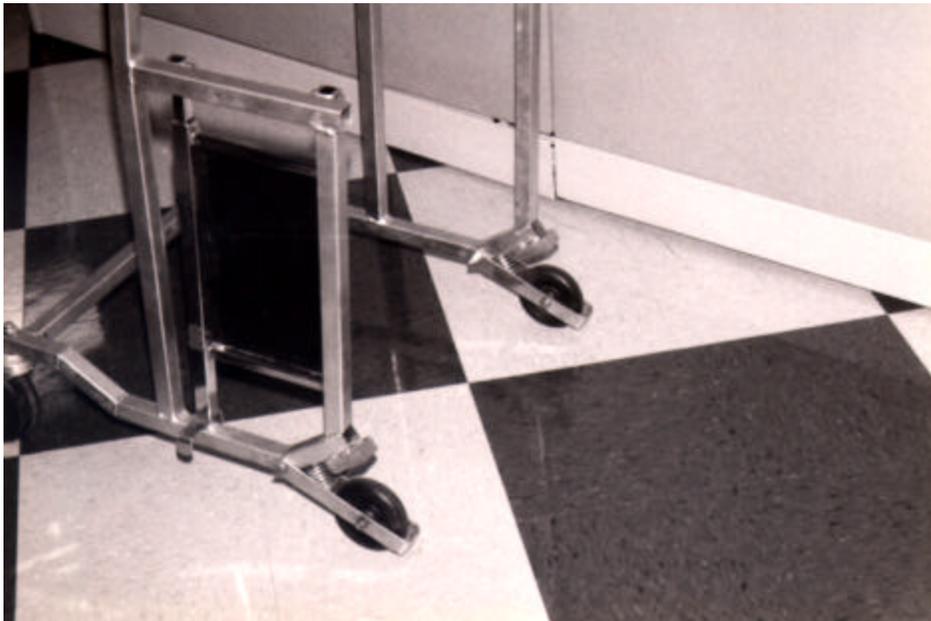


Figure 8.4. Braking Mechanism.

WHEELCHAIR SEAT WITH AIR ROTATION TO RELIEVE PRESSURE

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INTRODUCTION

A wheelchair seat was designed to relieve and rotate pressure by alternating airflow through the seat. This system is portable and can be used by both electric and manual wheelchairs.

SUMMARY OF IMPACT

Many wheelchair users remain seated in their chairs for an average of 14 hours a day. If users have no means of shifting their weight, occlusion of blood vessels can occur in high-level pressure areas of the support surface. By automatic rotation of pressure points, this seat will prevent such occlusion of vessels from occurring, especially in the area of the ischial tuberosities.

TECHNICAL DESCRIPTION

The system has two components, the seat cushion and a control box that straps on the back of the chair (Figure 8.5). The cushion contains rubber tubes that inflate and deflate in a set pattern for predetermined time cycles. The system is designed to support the user at alternating points on the seated area of contact, decreasing the inhibition of blood flow. A 12-volt 7-amp/hour, rechargeable battery powers the system. The cushion has a foam base to support the user, in case system failure occurs. Testing with a pressure mapping system demonstrated pressure relief and rotation.

The seat cushion control box is packaged in a waterproof bag, color-coordinated with the cushion in royal blue. The seat system was designed for average user specifications. The weight limit is 150 pounds, with a safety factor of 2. The seat was designed to be convenient and easy to operate. One power switch is



Figure 8.5 - Active Pressure Relief Cushion With Control Box.

placed on the armrest of the wheelchair to control the system. Once power is on, the cushion is fully automatic. A timer that has two independent time settings controls rotation. The on time setting activates the pump and opens one of two solenoid valves. The two solenoid valves control airflow in two groups of tubes (Figure 8.6). When the off time setting begins, the pump is turned off and a latching relay switches the direction of airflow. When the on time setting begins again, the pump inflates a different set of tubes. The first inflated set of tubes gradually deflates through an exhaust port on the attached solenoid valve.

The cushion consists of a 2-inch foam base of medium-soft foam. Four groups of four tubes lay horizontally on the foam base. The rubber tubes each have a 1-inch diameter. The groups alternate in an odd/even pattern of inflation. There is foam support on all four sides of the cushion. This seat is then covered in a replaceable waterproof covering. The final covering of the seat is made from 100% cotton, ma-

chine washable, lightweight material. The material breathes, allowing for moisture evaporation. Velcro attaches the covering, thereby enabling removal for washing. Air tubes, 3/8 " Tygon tubing, connect the cushion to the control box on the back of the chair.

Inside the control box, the tubes are connected to 3-way, 2-position solenoid valves. The solenoid valves are connected to a latching relay that switches power flow between the two valves. This creates the alternating inflation pattern. The relay and pump are connected to a timer that has two independent time settings. When power is supplied, the on time begins and the pump and relay receive power. When the inflation time is up, the timer switches to its off time cycle. Removal of power turns the pump off and causes

the relay to switch position. When off time is complete, on time begins again, and the pump creates air-flow through the other tube groups. The power switch on the armrest of the chair controls the system.

This system is fully automated and easy to operate. After a full day's use, a power cord coming from the control box can be plugged into an ordinary power outlet to recharge the battery. Recharging should be done overnight.

The final cost of this project was \$333.00. The T. K. Martin Center for Rehabilitation provided use of testing equipment at no cost.



Figure 8.6. - Air Tubes Imbedded in Cushion.

