CHAPTER 12
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Paralympic Prone Row Bench

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INTRODUCTION

The bench press is the only lift available to wheelchair weight lifters in competition, as opposed to three different types of lifts available for able-bodied athletes. The Client Coordinator would like to see additional lifts developed for wheelchair weight lifters. The Prone Row lift has the most potential for development because it uses the exact opposite set of muscles used in the bench press and because it places no stress on the spinal column. The lift requires the lifter to pull a barbell up to his chest while lying face down (prone) on a bench. An existing prototype exists but requires the wheelchair athlete to wheel up a ramp to the bench, approximately 40" above the floor. This transfer is not safe for the athlete. The Paralympic Prone Row Bench is designed to be lowered for easy accessibility and raised to the appropriate height for the lift to be executed. It also improves upon the previous prototype by allowing the lifter to bench press while the bench is in a lowered position. A linear actuator is used to raise and lower the bench. Aluminum tubes are used in its construction in order to reduce the weight of the design.

SUMMARY OF IMPACT

The development of the bench improves the potential of the Prone Row Bench to become an official event in the Paralympics. This would expand the number of lift events to three including the bench press, prone row, and combined.

The use of this bench by able-bodied athletes is also anticipated since the lift allows a complete stretch of the shoulder and back muscles. This not only improves the reach of the athlete, but improves the stability of the entire shoulder. Basketball and volleyball players might benefit from this type of exercise.

TECHNICAL DESCRIPTION

The bench as depicted in Figures 12.1 and 12.2 is designed for use by all weight lifters. Calculations are done using worst case scenarios; that is, the bench is designed to withstand a load of 1000 lbs. The main design requirements of the bench are: 1) the height had to be adjustable by electronic control; 2) it had to be compact and relatively easy to move around; 3) the angle of the lower body support had to be adjustable; and 4) there must be proper padding consistent with that used for conventional benches. Of course, safety is an important factor in the design. The factor of safety against failure for all components is 1.5 or greater. The deflection of the bench is also limited.

The bench consists of three main components: 1) forward and rearward body supports; 2) the legs and roller tracks; and 3) the actuator system. Both use ½" birch plywood upholstered with conventional weight bench padding. The rearward body support is a sandwich structure with plywood over 1.25" square aluminum tubing. It is connected to a 4" square aluminum torsion bar with hinges to allow for rotation and a more comfortable lift position. At an inclined position, two caster wheels mounted to the cross support on the scissors mechanism (Figure 12.1) guide the lower support to a horizontal position while it is being lowered. The forward body support is a cantilevered structure reinforced by three tapered gussets welded onto the bottom and sides of the 4" square aluminum torsion bar.

The scissors legs are made of 2"x 4" aluminum tubing, rounded at the ends. The legs are stabilized by a 2"x 4" rectangular crosspiece at their intersection. Bronze bushings are used at the pin-jointed ends of the legs to minimize friction during rotation and to prevent compression of the beams when bolting them together. Grade 5 bolts with nylon lock nuts are used at the pin joints. The tracks consist of 3"x 5" aluminum rectangular tubes. The sides of each track are machined with slots to accommodate v-groove stainless steel bearings that roll on stainless steel guides.

An electric ball screw actuator system powers the bench up and down. The linear actuator is connected at both ends by two brackets welded onto 2” x 4” aluminum beams. One of them is fixed to the front end of the bottom tracks, while the other is fixed across the outer pair of legs. Grade 5 bolts are used to attach the brackets. Using the companion control box, the bench can be raised by retracting the actuator or lowered by extending it. The maximum raised height of the bench is 40” and the minimum lowered height is 19”. The actuator has a 1000-lb. dynamic capacity and a 4000-lb. static capacity.

The cost of the Prone Row Bench is approximately $3,200. Most of these funds are provided by contributions through the Athletic Department at the University of Hawaii.

Figure 12.1. Side View of Prone Row Bench.

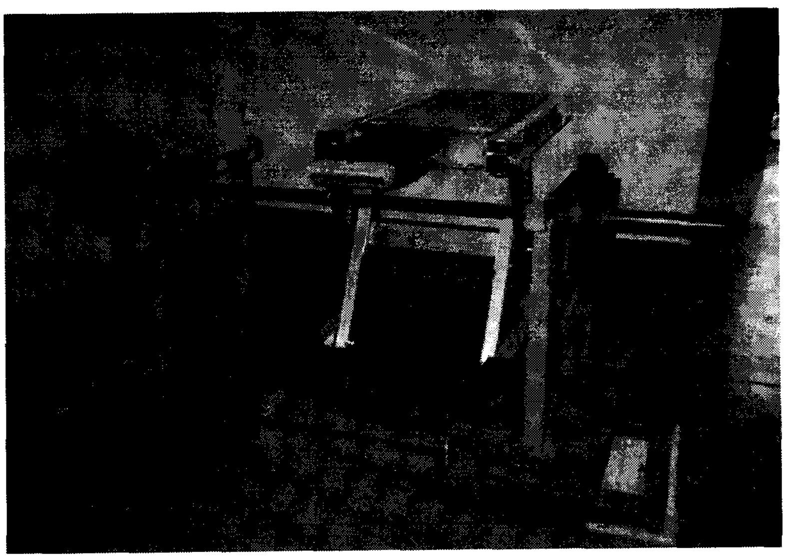

Figure 12.2. Front View of Prone Row Bench

Paralympic Throwing Chair

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INTRODUCTION

The participation of paraplegic athletes in the upcoming 1995 Atlanta Olympics Games, along with changes in "wheelchair" design requirements and restrictions necessitates the creation of new paraplegic performance enhancing equipment. In particular, athletes who compete in field events such as the discus, javelin, and shot put require special chairs for competition that are custom designed to fit their needs. The degree of modification that can be performed on these chairs is limited, however, because it must conform to the rules and regulations of the Wheelchair Sports, USA, a member of the United States Olympic Committee.

When paraplegic competition first began, competing athletes would strap their wheelchairs to the ground using cables in an effort to keep the chair stationary and ensure that it remained within the throwing circle. These athletes are essentially using the same, ordinary wheelchairs to perform and compete in athletic events. As the sport continued to grow, however, these athletes began to remove their wheels and prepare a chair strictly for competition. Also, there is an underlying goal to compete on a level that is on par with that of "normal" (non-disabled) athletes. Thus, we are now seeing the emergence of more technologically advanced chairs with higher seats that allow the competitor a fuller range of motion in the wind-up and swing while simultaneously allowing the thrown object a greater vertical range. This will hopefully result in improved athletic performance and better-thrown distances.

Currently, there are no commercially available chairs that cater to the needs of the paraplegic field athlete. While there may be a significant need for this product, the appeal would be severely limited and impractical. **A** commercial chair would have to be extremely adjustable or custom built because even though athletes may compete in the same class division, they do not necessarily have the same throwing style or technique.

Jeffery Sampaga, a seasoned veteran in Paralympic competition, who is once a World, Pan Am discus and National javelin record holder and who currently holds the National record in the discus event, needed a new throwing chair in order to compete and comply with the new changes in the regulations. Mr. Sampaga's original record setting chair is nothing more than a modified wheelchair. The inessential wheels had been removed and the remaining frame is mounted on a heavy square base. Through the years, this chair has proved more than adequate in allowing Jeff to perform properly in the discus and the javelin events. Yet, he has never been able to find a comfortable throwing position for the shot put event. Jeff is also concerned that he is not taking advantage of the increase in the maximum allowable height of the chairs of 75 centimeters, which would probably have a considerable positive affect on his throwing distances. For these reasons, it is decided to assist Mr. Sampaga in designing and constructing a new and improved Olympic field competing chair.

SUMMARY OF IMPACT

The specially designed throwing chair has allowed Mr. Sampaga to achieve distances that are comparable to those obtained with his previous chair. It is anticipated that with continued practice, he will be able to exceed his former record achievements.

TECHNICAL DESCRIPTION

The final design, depicted in Figure 12.3, is developed by generating a solid model and performing finite element analysis on I-DEAS (Integrated Design Engineering Analysis Software). The throwing chair is primarily designed to provide the user with a sling-type seat commonly found on wheel chairs. The maximum allowable height of the chair is 75 centimeters, so the top of this chair is set at 63.5 centimeters, to allow for the use of a thick cushion or pad to provide comfort.

The legs of the chair are made by welding four rectangular 1" X 2" tubes into a trapezoidal shape. These legs are then joined by bolting four rectangular tubes as crosspieces to the front and back. Bolts are used so that the chair could be dismantled and easily transported on airlines. Additionally, round tubes are welded into positions that serve as sleeves for both the armrests and backrest. They are removable and adjusted vertically. A footrest is welded onto the lower forward connecting cross piece. The rectangular tubing is 6063-T52 aluminum, and the circular tubing is 6061-T6 aluminum. A tubular aluminum throwing support arm is designed to provide leverage for the shot put throw.

The chair can be disassembled with little effort and fits comfortably within the space of an average suitcase. It is lightweight, with a total weight of only about thirty pounds. The design is structurally sound and amply supported weight and forces exerted by Mr. Sampaga. We look forward to seeing Mr. Sampaga compete successfully in this chair at the Paralympic games (Figure 12.4).

The cost of the final throwing chair is approximately $750.

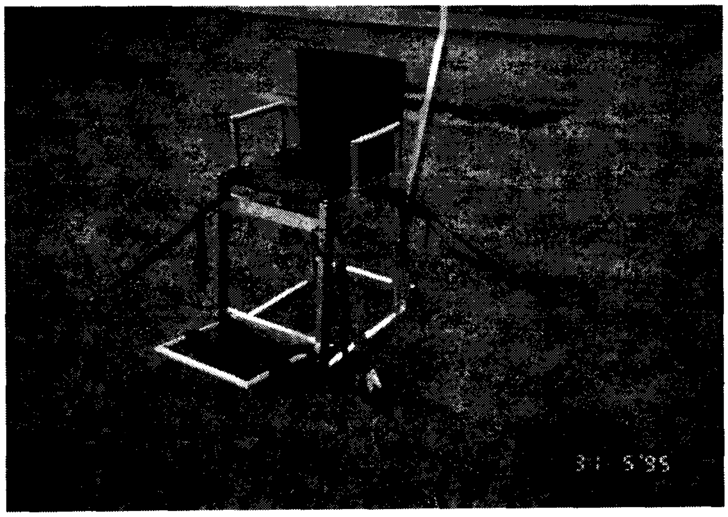

Figure 12.3. Paralympic Throwing Chair.

Figure 12.4. Mr. Jeffrey Sampaga in Javelin Throw Position.