Globus: An International Journal of Medical Science, Engineering and Technology
A Refereed Research Journal
Vol 3 / No 2 / Jul - Dec 2014 ISSN: 2319-8958

# A STUDY ON REHABILITATION TECHNOLOGY SUPPLIERS

*Abhijit Basu

**Abstract**

Proper materials for an assistive device cannot be selected without understanding some basic characteristics of the final product and the user's intentions for the product. The rehabilitation engineer must ask: how will the device interact with the user? Material selection and the design itself are affected by the answer to this question. If the device is to come into contact with the user it should not cause abrasion, allergic reaction, or discomfort. The device may come into contact with body fluids, which must not create a hazard for the consumer or for the device. Devices must also consider the cognitive abilities of the prospective user. Cognitive ability will affect material and component selection, and may require greater safety consideration.

**Keywords**: Rehabilitation Technology.

## Introduction

Consumers and rehabilitation professionals have relied heavily on the knowledge of rehabilitation technology suppliers for product information.

The National Association of Medical Equipment Suppliers (NAMES) has recognized the need to develop standards of practice for rehabilitation technology suppliers (NAMES 1992). Standards of practice help to ensure quality service from NAMES members. NAMES are made up of manufacturers, dealers, clinicians and consumers. Rehabilitation technology suppliers provide assistive technology and services to people with disabilities. Rehabilitation equipment is different from other durable medical equipment in that assessment and evaluation of the technology to meet the client needs is an integral part of the specification process: the equipment and/or components may be customized to meet the client's goals. Rehabilitation technology suppliers are commonly an integral part of the rehabilitation team. Often the rehabilitation technology supplier is responsible for making the methods and terms of payment clear to the consumer, and for providing service and maintenance for the technology.

## Rehabilitation Engineering Design

Design is deliberate purposeful planning. Rehabilitation engineering design may be defined as deliberate purposeful planning applied to assistive technology. In many senses rehabilitation engineering itself may best be defined as rehabilitation engineering design. The design skills of the rehabilitation engineer are what distinguishes him or her from the other members of the rehabilitation team. Heuristics, one of the oldest design methods, is often applied to assistive technology. When using heuristics, the engineer imagines that the device is completed and that the consumer is using it. By imagining that the problem has been solved certain conditions are met. By working one's way backwards from the solution one can develop the criteria necessary for the design. This approach has been applied to solve many complex design problems.

For example, let us say we would like to design a power wheelchair for use by people with quadriplegia. We start by saying the power wheelchair will be used indoors and outdoors. Hence, we choose to use electricity to power the wheelchair so that the noise and fumes will not present a problem indoors. We choose to use batteries (Gel Cell Marine batteries for cost and

durability) because mains electricity may not always be available outdoors, but because we use batteries we have limited power. We do not want anybody to get stuck somewhere so we want to minimize the energy drain on the batteries. For this reason we choose to use a switching servo amplifier in a full H-bridge (so the chair can go forwards and backwards). We can get simplicity, high torque, and eliminate the need for a negative supply voltage by using a permanent magnet d.c. motor. This allows us to work on a 24 V system (two 12 V batteries in series). We use an oil-filled, sealed gear box to keep noise and maintenance down (we do not want dirt to damage our wheelchair). Since we selected a high-torque motor, the frame needs to be designed to accommodate it. We select a chromium molybdenum steel alloy for the frame because of its high strength and good machinability. Wide-profile pneumatic tires were selected to provide the user with some shock absorption. A simple linear seating system was selected because it can accommodate a variety of user needs. The wheelchair was designed to be controlled with a joystick because of the user‘s limited upper-limb function. By working backwards each previous step can be worked out; from there the design criteria can be developed for individual components.

One of the first steps in the design process is to define when the problem is solved. Generally, the rehabilitation engineer will sit with the consumer and they will discuss the problems the consumer has identified. The rehabilitation engineer will assist in defining the problem and then translate the problem into design criteria. At this point it is best if the rehabilitation engineer, the consumer and others on the design team meet to refine the problem and the design criteria. Once the problem has been defined, then ideas need to be generated to solve the problem. Typically there are numerous solutions to a single problem. All solutions have their merits; a key issue is finding a solution that best meets the consumer‘s needs.

To be successful at creating innovative solutions to problems one must be able not to rely too heavily on past experience. Although past experience is valuable, it often limits our perspectives and it may hide important solutions to the problem. A popular method for forming new ideas is called brainstorming. Brainstorming simply requires assembling a group of people with some knowledge in the problem area and letting them present numerous solutions to the problem.

A popular method for forming new ideas is called brainstorming. Brainstorming simply requires assembling a group of people with some knowledge in the problem area and letting them present numerous solutions to the problem. There are only two rules to brainstorming: (1) the ideas should meet the need and (2) criticism of any sort is forbidden.

Once brainstorming is complete, there should be many more ideas for-solutions than are needed. The best ideas must be selected for further-development. This is critical to the success of the design. It is important to remember that all are solutions to the problem; the process is to select the best solutions. Once the most promising ideas have been selected, details are added until a final design is selected. After the final design is selected, either the device is built, another idea is selected or the brainstorming begins again. If the final design is built, it must be evaluated and then refined or discarded based upon the results.

## The Device

Proper materials for an assistive device cannot be selected without understanding some basic characteristics of the final product and the user‘s intentions for the product. The rehabilitation engineer must ask: how will the device interact with the user? Material selection and the design itself are affected by the answer to this question. If the device is to come into contact with the user it should not cause abrasion, allergic reaction, or discomfort. The device may come into contact with body fluids, which must not create a hazard for the consumer or for the device. Devices must also consider the cognitive abilities of the prospective user. Cognitive ability will affect material and component selection, and may require greater safety consideration.

Rehabilitation engineers must be able to determine or reasonably estimate the intended or expected loads and stress the device will experience. The environment in which the device will be used and the frequency of use will affect the evaluation of the required mechanical and electrical properties of the device. Depending on the intended use and the environment a device may require a metal or plastic case and be battery operated. A wheelchair frame may be made of aluminum for active users. The intended use will also affect the design as well as the materials.

Often people use multiple assistive devices to perform functions of daily living and for their vocation. The design of a device must consider how it will be integrated into the users existing technology. Such considerations as power consumption, size, weight, and flexibility are affected by the technology with which the device or devices are to be integrated.

Material selection varies depending upon the type of device to be designed. Mechanical, electronic, electrical, and electromechanical devices all have properties to be considered when designing an assistive device. Many devices integrate components from each of these areas. Mechanical design may incorporate the structural components of a device as well as the packaging. Mechanical design may also involve heat flow considerations.

Electrical considerations may include supplying and controlling power to the device or communication with other devices. Electronic design is involved with coordination and control of electronic devices. Electronic design can be used for computer control of devices or for digital communication. Electromechanical design involves the conversion of electrical energy into mechanical energy and vice versa. The design and selection of motors and their drive circuitry is the primary application of electromechanical design to assistive technology.

Assistive technology must assist a person to perform a task prescribed by that person. However, merely meeting user-designed performance goals will not necessarily be met with satisfaction: as assistive technology often becomes an integral part of one‘s personal appearance, and when successfully designed can become an expression of self-image. Therefore aesthetic considerations have to be evaluated throughout the design process.

A good rule of thumb to follow is to make the device as unobtrusive as possible. When viewing a person with a disability the assistive technology should not detract from the person. There are two approaches to this: (1) the device is designed to be small and essentially transparent or (2) the device is blended into the user’s persona. In the second case the concept is to integrate the user and the device such that the device becomes a reflection of the user. This is an effective means of integrating larger devices such as wheelchairs.

## Reference


1. Oehlers, D., & Bradford, M. (1995). Composite steel and concrete structural members-Fundamental behaviour. Oxford: Pergamon Press.
2. Poh, K., & Attard, M. (1993). Calculating the load-deflection behaviour of simply supported composite slabs with interface slip. Eng. Struct, 15(5), 255–285.
3. Porter, M., & Ekberg, C. (1976). Design recommendations for steel deck floor slabs.
4. J. Struct. Engg., ASCE, 102 (ST11), 2121–2136.
5. Porter, M., Ekberg, C., & Greimann, L. (1976). Shear-bond analysis of steel-deck reinforced slabs. Journal of Structural Engineering, ASCE, 102(12), 2255–2268.
6. Vainiunas, P., & Valivonis, J. (2006). Analysis of longitudinal shear behaviour for composite steel and concrete slabs. Journal of Constructional Steel Research, 62, 1264–1269.
7. Veljkovic, M. (1998). Influence of load arrangement on composite slab behavior and recommendations for design. Journal of Constructional Steel Research, 45(2), 149–178.
8. Wright, H., Evans, H., & Harding, P. (1987). The use of profiled steel sheeting in floor construction. Journal of Constructional Steel Research, 7, 279–295.
9. Davis, Allen G., Carlton A. Olsen and Kevin A. Michols, Evaluation of Historic Reinforced Concrete Bridges,‖ Structures 2001, A Structural Engineering Odyssey, ASCE Structural Engineering Institute, Washington, DC, May 2001.
10. Dexter, R., K. Johns and R. Di Bartolo, Smart Sign Support, Civil Engineering, Volume 17, pp. 62–65, September 2000.
11. Dunker, K. and L. Dajin, Foundations for Integral Abutments,‖ ASCE Practical Periodical on Structural Design and Construction, Volume 12, Issue 1, pp. 22–30, February 2007.
12. Historic Bridges Evaluation, Preservation and Management, edited by Hojjat Adele, CRC Press, April 2008.
13. Life Cycle Cost Analysis Primer, Office of Asset Management, Federal Highway Administration, Washington, DC, August 2002.
14. Miller, Ann B., et. al., Final Report: A Management Plan for Historic Bridges in Virginia, Virginia Transportation Research Council, Charlottesville, VA, January 2001.
15. Movable Bridges, Operating Complex Systems, New Jersey Department of Transportation Structural Design Bureau, Trenton, NJ.
16. Perrow, Charles, The Next Catastrophe: Reducing Our Vulnerabilities to Natural, Industrial, and Terrorist Disasters, Princeton University Press, Princeton, NJ, March 2007.
17. Priority Repair Procedure, New Jersey Department of Transportation Bureau of Structural Evaluation, Trenton, NJ, January 2008.
18. Rong, Alex, Structural Analysis of an Ancient Arch Bridge Using Modern Technology,‖ Structures 2004, Building On The Past: Securing The Future, ASCE Structural Engineering Institute, Nashville, TN, May 2004.
19. Shenton, III, Harry W., Michael J. Chajes, William W. Finch, Jr., Scott Hemphill and

Rick Craig, Performance on a Historic 19th Century Wrought-Iron Through-Truss Bridge Rehabilitated Using Advanced Composites,‖ Advanced Technology in Structural Engineering Proceedings of Structures Congress 2000, American Society of Civil Engineers, Philadelphia, PA, May 2000.

20. Steel Bridge Design Handbook, Chapter 23, Corrosion, National Steel Bridge Alliance.
21. Survey Results of Bridge Maintenance Practices in the Midwest,‖ Federal Highway Administration, Washington, DC, May 2000.
22. Umphrey, J., Derek Beck, G. Ed Ramey and Mary L. Hughes, Rapid Replacement of Four GDOT Bridge Decks,‖ Practical Periodical on Structural Design and Construction, Volume 12, No.1, pp. 48–58, February 2007.
23. Zhou, Y. E., Fatigue Problems in Steel Bridge Structures, Structures 2004, Building On The Past: Securing The Future, ASCE Structural Engineering Institute, Nashville, TN, May 2004.