

Ethnographic and Ergonomics considerations in design of Wheelchair

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Abstract: Quite a significant number of people are unable to walk freely due to some or the other problem with their limbs. Because of physical disabilities like paralysis, blindness, polio and other deficiencies, thousands of people fail to walk. At times a disability can make the person a temporary user of the wheelchair. This work focuses on benefits of introducing ethnographic research into specifically design engineering field. In ethnographic study, attitude of people or groups of people regarding disability problem are studied. Such method of research can be very useful in analysing the reliability of a design of engineering product. Ethnographic research is done through participant observations and field work. Hence the need arises for the ethnographic research of human factor and ergonomic study for the design of wheelchair.

Keywords: Wheelchair, ethnography, ergonomics.

1 INTRODUCTION

A wheelchair is a seat fitted with wheels. The wheelchair comes in varieties permitting either manual drive by the situated inhabitant turning the back wheels by hand, or electric impetus by engines. There are handles, frequently behind the seat to permit it to be pushed by someone else. Wheelchairs are utilized by individuals for whom strolling is troublesome or unimaginable because of ailment, damage, or inability. Individuals who experience issues sitting and strolling regularly make utilization of a wheel seat.

Overwhelming effort shocks our joints and causes undue strain in muscles. Wheelers have their own particular manner of inciting stress while snapping their arms toward the end of a push that thusly puts undesirable weight around the shoulder joints. The quantity of pushes can be minimized by drifting (that implies keeping the tires swelled and the seat well be kept up) while moderate speed can likewise be beneficial as more pushes are required for going faster [1].

The paper did not identify one specific wheelchair to meet user requirements. This is due to the wide range of abilities and needs of user, the various types of wheelchair options in the market that suit their personal needs and the type of terrains/environment the wheelchair will need to access.

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Many difficulties regarding operating the wheelchair

should get reduced also we consider ergonomic factors which will be helpful in ease of operation of wheelchair.

Ethnographic research is an emerging branch of research which uses scientific techniques like anthropology and sociology. Ethnographic research is done through participant observations and field work. In ethnographic study, mind set of people or groups of people are studied. Such method of research can be very useful in analysing the reliability of a design of engineering product. Further this work will be focusing on the design of a wheelchair, and investigates devices available to disabled users and looks at the design of a modern, performance option aiming to improve the usability of a wheelchair.

2 COMPONENTS OF MANUAL WHEELCHAIR

A manual wheelchair is the most common type of wheelchair which is used by most of the people for locomotion and for other purposes [2].

Simple manual wheelchair is shown in the figure 1 as follows

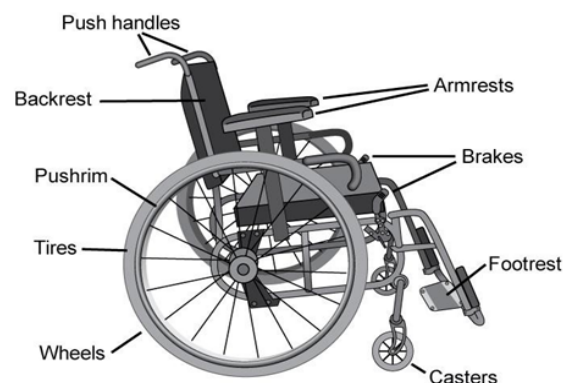


Figure 1: Simple manual wheelchair

Wheelchair frame: The frame of the wheelchair is the component that holds all the other components together and determines the type of wheelchair that will result from assembly. Standard weight wheelchairs will usually have

steel frames, light weight wheelchairs will usually have aluminium frames and ultra-light frames can be made of either aluminium or titanium frames.

Wheelchair Arm sets: There are a variety of wheelchair arm rests on the market to meet the needs of various types of wheelchair users.

Wheelchair foot rests: There are two or three types of foot support for a wheelchair. The two most common are generally known as "footrests" and "legrests".

Wheel chair wheels: The rear wheels on a manual wheelchair come in several different sizes and a couple of different styles as normal options. Generally speaking the larger the wheel, the easier propulsion will be and the wider the wheel, the better they will be able to roll over softer terrains such as lawns.

Wheel chair Brakes: Contrary to popular belief, wheel locks on wheelchairs are not brakes. Brakes would be used to slow down and stop a wheelchair but that is not the purpose of wheel locks.

Wheel chair casters: Wheelchair casters come in a variety of diameters and widths and each different style and size will have its own attributes that make it appropriate for different applications.

3 ETHNOGRAPHY

The "Ethnography" is derived from the Greek signifying "an organization, later a people, country" and '-graphy signifying "field of study". Ethnographic studies concentrate on expansive social gatherings of individuals who associate after some time. Ethnography is a subjective plan, where the analyst clarifies about shared, learnt examples of qualities, conduct, convictions, and dialect of a culture shared by a gathering of individuals.

Ethnographic research or study is sometimes considered as science and sometimes it is considered as art. As it studies minds of people, it is called as art and as it uses scientific techniques like anthropology and sociology. It is a type of qualitative research in which knowledge gain occurs about thoughts, opinions, and motivations by various data collection methods. Ethnographic research is useful in many areas. It can be used in areas like schooling, development of urban or rural areas, public health, use of various commodities (Electronic, technical, economic), any area which is associated with human arena[3].

Ethnographic Research involves examination of not very many cases, perhaps only one case, in detail. Often includes working with essentially unconstructed information. This information had not been coded as the purpose of information accumulation was a shut arrangement of

logical classifications. It emphasizes on investigating social wonders as opposed to testing speculations. Data examination includes elucidation of the capacities and implications of human activities. The result of this is principally verbal clarifications, where measurable examination and measurement assume a subordinate part. It includes taking part in broad field work where information gathering is for the most part by meetings, images, relics, perceptions, and numerous different wellsprings of information.

4 PROCEDURE FOR CONDUCTING ETHNOGRAPHY

- Determine if ethnography is the most suitable plan to use to ponder the examination issue.
- Then distinguish and find a culture sharing gathering to examine.
- Select social topics, issues or speculations to learn about the gathering.
- For concentrating on social ideas, figure out which sort of ethnography to utilize.
- Should gather data in the specific situation or setting where the gathering works or lives.
- From the numerous sources gathered, the ethnographer breaks down the information for a portrayal of the way of life sharing gathering, topics that rise up out of the gathering and a general understanding
- Forge a working arrangement of standards or speculations regarding how the way of life sharing gathering fills in as the last result of this examination.

5 ETHNOGRAPHIC RESEARCH OF WHEEL CHAIR

Ethnographic study for design analysis of wheelchair will be fruitful when more than one human dimension will be considered for ethnographic research data collection. We identified, various personnel associated with working of wheelchair are

- 1 Doctors or owners of hospitals.
- 2 Attendants who actually propel the wheelchair
- 3 Patients who actually gets access to the wheelchairs.

Selection of various personnel is an important step in methodology of project work. As we know, ethnographic research is done by various methods like participant interviewing, participant observation and by using archived research. In case of participant observation and interviewing, primary data is generated for research work and in case of use of archived research; secondary data will be used for research work [4].

Detailed methodology of ethnographic research work will contain certain survey forms for various personnel associated with working of wheelchair are

- 1 Doctors or owners of hospitals.

- 2 Attendants who actually propel the wheelchair
- 3 Patients who actually gets possession of wheelchairs.

These forms will be included with different questionnaires from the obtained data we can analyze the difficulty in using the component. The questionnaires are shown through graphs as below.

Ethnographic research suggests the following points after critical analysis carried out using various survey forms

Ethnography of Patients [5].

- The weight of a wheelchair is more because of which patients feel it difficult to propel the wheelchair.
- Seating position should be proper so that patient will feel comfortable while using it.
- Availability of few components depends upon the type, extent of injury of a patient.
- Factors like Automation should be considered for innovation in a wheelchairs

Ethnography of Attendants

- Force required for pushing the wheelchair can be further reduced.
- Light weight wheelchairs can simplify the operation of a wheelchair
- Turning radius of wheelchair should be reduced
- Maintenance of wheelchair should be as minimum as possible.
- Wheelchair ergonomics is another factor of improvement.

Ethnography of Doctors/Managers

- According to Doctors, managers, wheelchairs should have less weight so that they can be used by patients effectively
- Doctors feel that issues like automation, maintenance reduction should be worked on.
- Wheelchair should be designed to carry and sustain the weight capacity over 80 kgs.
- Maintenance of a wheelchair is one of the most common issue about manual wheelchair
- Aesthetically, wheelchairs can be further improved in dimensions, comfort, and better accessories of wheelchair

Based on the suggestions above design of wheel chair has to be carried out. And comfortable level of ergonomics and

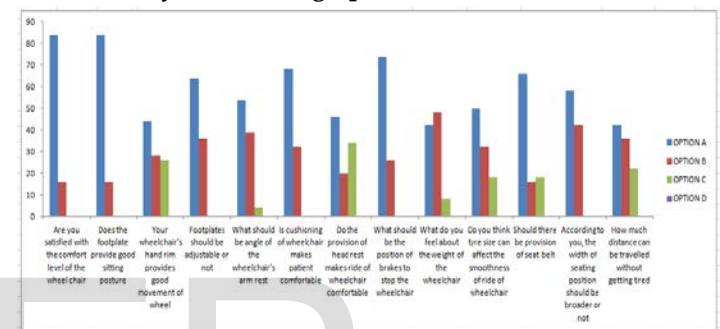
cost of the product should be taken as a concern factor.

6 ERGONOMIC ASPECTS OF WHEEL CHAIR

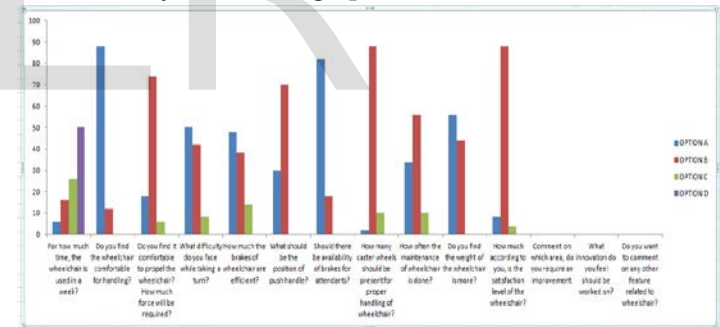
Ergonomics is the scientific discipline concerned to understand the interaction between human beings and element of the system where he is living. It is employed in fulfilling the goals of health and productivity. Wheelchair users in particular face the problem of being forced to spend long periods in the same position. The result can be pain, deformatities and decubitus ulcers [3].

Ergonomics deals with four key criteria. Force, Repetition, Duration, Posture.

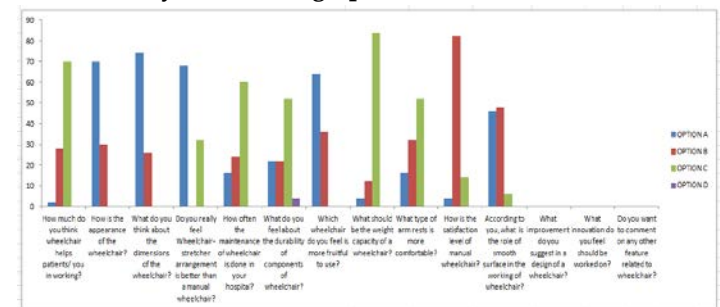
Critical Analysis of Ethnographic Research of Form No.1



Critical Analysis of Ethnographic Research of Form No.2.



Critical Analysis of Ethnographic Research of Form No.3.



Let us consider how they apply to wheeling.

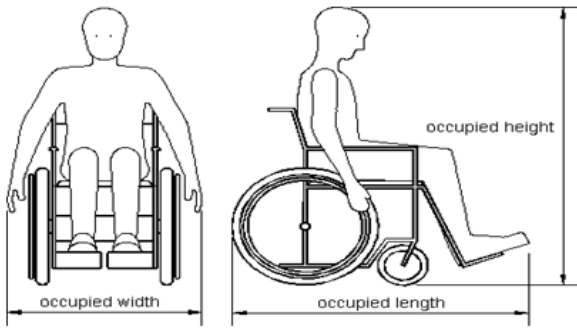


Figure 2. Diagram for occupied width, height and length



Pressure Sensitive areas
Figure 2.1. Side View. Figure 2.2. (Back View)

Seating and postural support elements

Wheelchairs provide postural support and sitting as well as mobility. Good postural support is very important, especially for people who suffer unstable spine or are likely to develop secondary deformities. Good seating and postural support have high significance can mean the difference between the user being active and an independent member of society and the user being completely dependent and at risk of serious injury or even death. Seating and postural support is provided by all body contacts. All these parts together of the wheelchair help the user to maintain a functional posture and comfort and to provide pressure relief. This is important for people who have problems like sensation in skin. [3]

Table 1. Typical values (in mm)

	Manual wheelchair	Electrically powered wheelchair		
		Class A	Class B	Class C
Occupied length	1200	1240	1300	1300
Occupied width	740	620	680	700
Occupied height	1500	1500	1530	1590

Table 2. Recommended maximum limits (in mm)

	Manual wheelchair	Electrically powered wheelchair		
		Class A	Class B	Class C
Occupied length	1300	1300	1300	1300
Occupied width	800	700	700	700
Occupied height	1600	1600	1600	1600

Human Dimension And Ergonomic Study

Ergonomics is the methodical discipline concerned to comprehend the interaction between human beings and various elements of the system where a person is living. Ergonomics is employed in fulfilling the goals of health and productivity.

Ergonomics with wheelchair users

Ergonomic study of wheelchair is the interaction in relation to various aspects of vehicle mechanics and user's physical and mental condition. Wheelchair designed ergonomically reduces the strain that is caused due to longer use of product. Ergonomics in the wheelchair considers four main criteria's like force, repetition, duration, posture [6].

MINIMAL REACH DIMENSIONS

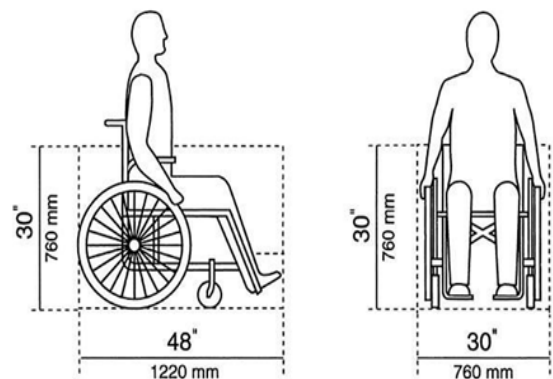
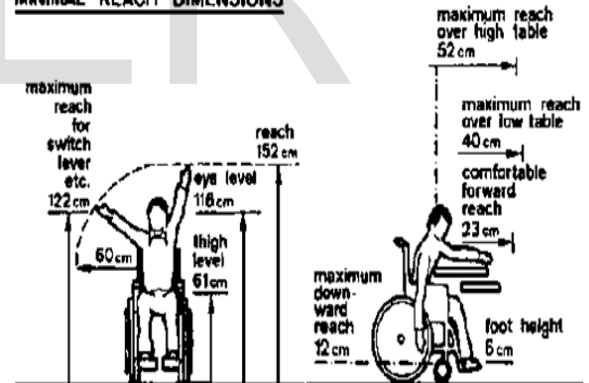


Figure 3 Human dimensions on wheelchair

7 RESULTS

The ethnographic research data and the ergonomic factors are considered in modeling the wheelchair so that the patients have the comfort as they expected. The figure 4 shows the 3-d model of the wheelchair.

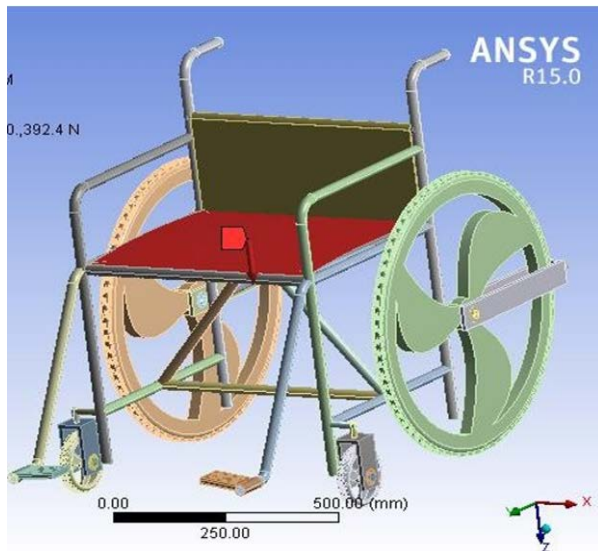


Figure 4. 3D model of Wheelchair

A static structural analysis is carried out on the wheelchair to analyze values of displacements, stresses, strains and forces on structure or a component due to load application. There are various types of loading that can be applied in this analysis which are externally applied forces and pressures. The wheel chair is analyzed to investigate the stresses induced in the component for various materials when it is loaded under different conditions. The analysis is carried to check whether the wheelchair sustains the applied load or not.

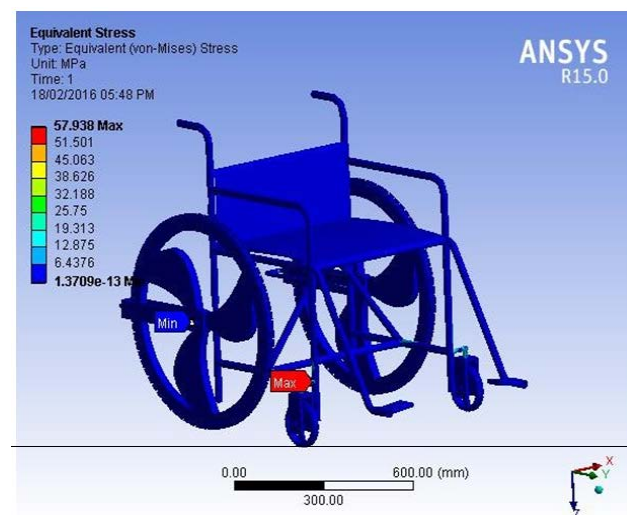


Figure 5. Equivalent Von-Mises Stress of Wheel Chair (Steel 60 Kg)

The figure 5 shows equivalent Von-Mises stress of wheel chair made up of Steel tube with loading condition as 60

kg person. Here, from the figure we can get clear idea regarding all the stresses induced in the component in static loading condition. The maximum stress induced here is 57.938 Mpa which is too below the ultimate stress of the steel.

8 CONCLUSIONS

The information via survey and consultation to determine the type and extent of difficulties experienced in relation to wheelchair provision and current prescription practices for aboriginal people were collected and critically analyzed. Options that would improve function of wheelchairs were found out with the help of ethnographic research with help of inputs given by various patients, users, attendants and doctors in problems identifications and solving problem of wheelchairs.

3D model prepared by the study of ethnography and ergonomics of the wheel chair. Finite element analysis is carried out in respect to solve the problem which is identified with the help of Ethnographic research.

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