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Design and Fabrication of Multiutility Chair

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Abstract:**This work is proposed to design and fabricate a "Multi-utility Chair" to ease the use of the product. It involves an idea of integrating the chair with desk and locker by considering some vital factors, such as ergonomics and anthropometrics for enhancing the human comfort at economical price, minimizing the floor space requirement for individual furniture. The design is made along with the fabrication of a prototype that is demonstrated at the end of this paper. Process involves usual design steps, starting from sketching the different possible concepts, optimizing and modeling the product using 'solid edge ST4' package, followed with fabricating the virtual model into a real-time prototype, using methods such as cutting, welding, drilling so on.**

Keywords: Anthropometry, Ergonomics.

I. INTRODUCTION

One could imagine that there are as many different types of chairs as many as types of people. It is an object that needs to most everyone. In its different embodiments it can be humble or regal, made of traditional wood or high-tech polymers, simple in concept or highly charged with meaning. Fundamentally, the requirements for a chair are few. It is essentially a horizontal surface at a logical distance from the ground meant to support the human body while sitting. A vertical surface is provided for back support. It can have arms or be armless. While these are the basic elements, a chair is more than the sum of its component parts. The psychological relationship with the user, perhaps stronger than with any other type of furniture, can connote symbolism about status and beliefs.Chair design considers intended usage, ergonomics (how comfortable it is for the occupant), as well as non-ergonomic functional requirements such as size, stack-ability, fold-ability, weight, durability, stain resistance and artistic design. Intended usage determines the desired seating position. Easy chairs for watching television or movies are somewhere in between depending on the height of the screen.

Ergonomic design distributes the weight of the occupant to various parts of the body. A seat that is higher results in dangling feet and increased pressure on the underside of the knees. It may also result in no weight on the feet which means more weight elsewhere. A lower seat may shift too much weight to the "seat bones". Hence there is a great need to develop ergonomically good chair to reduce the pressure on human body. This requires a detailed study of Anthropometry i.e., the human body on measurements like height, breadth and length of various human body parts for his/her maximum comfort.

A locker is a small, usually narrow storage compartment. They are commonly found in dedicated cabinets, very often in large numbers, in various public places such as locker rooms, workplaces, middle and high schools, transport hub and the like. They vary in size, purpose, construction, and security. Lockers are usually physically joined together side by side in banks, and are commonly made from steel, although wood, laminate, and plastic are other materials sometimes found. , in various public places workplaces, middle and high schools, transport hub and houses the lockers are placed separately and at some distance. And these lockers cannot be frequently accessed.

Now-a-days, individual components are integrated, because products are expected to have maximum features embedded in a single package, so as to make it smart and economical. This work entitled with "Design and fabrication of multi-utility chair" is intended to do such an improvement in the design by integrating chair for an individual with desk and a locker.

II. CONSIDERATION OF ERGONOMICS AND ANTHROPOMETRICS RELEVANT TO CURRENT WORK

Age, sex, race, geographical regions, even different occupations all influence human body dimensions. Accurate dimensions of clothing and personal equipment used by persons, e.g. headgear, footwear, spectacles, lifesaving and support equipment would be of great value because human functional dimensions and the range of movements possible demand that appropriate allowances should be made when specific designs are developed.

The general problems encountered in seats not matching the body are shown in figure 3.1. To overcome these problems, anthropometric dimensions are studied for different percentile and suitable anthropometric dimensions are selected for the multi-utility chair as product specification.

The product specifications are determined through the detailed study of static Anthropometric data of human body in seating position like Hip breadth & Mid-thigh-to thigh breadth (Fig 2.2), Buttock to popliteal length (Fig 2.3), Height of popliteal from ground (Fig 2.4), Free leg room (Fig 2.5), Elbow height from sitting surface (Fig 2.6), Curvatures of sitting surface (Fig 2.7).

Fig 2.1 to Fig 2.7 courtesy [1].

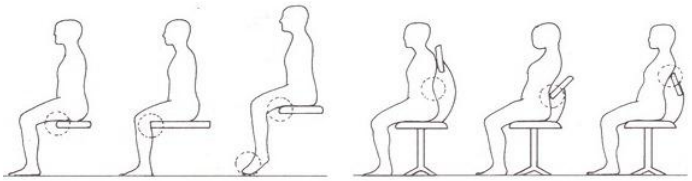

Fig 2.1: Problems faced due to mismatch of human body and seating

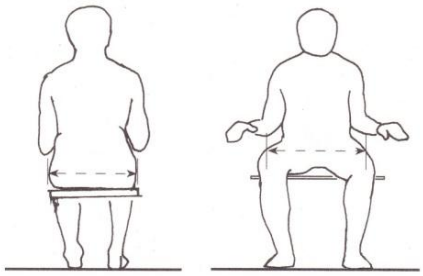

Fig 2.2:Hip breadth& Mid-thigh-to thigh breadth

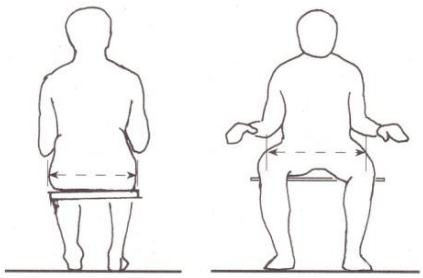

Fig 2.3: Buttock to popliteal length

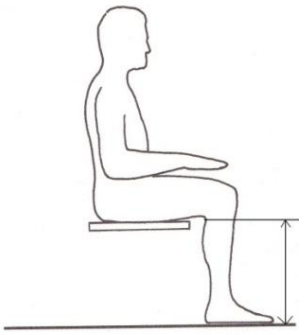

Fig 2.4: Height of popliteal from ground

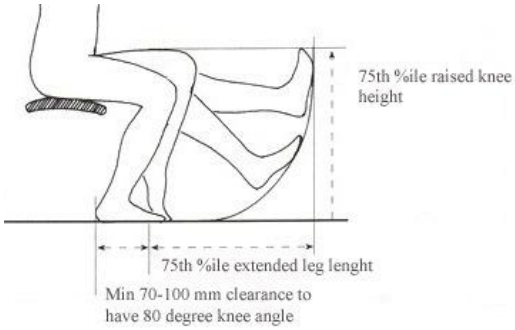

Fig 2.5: Free leg room

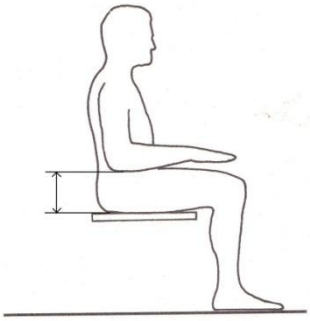

Fig 2.6: Elbow height from sitting surface

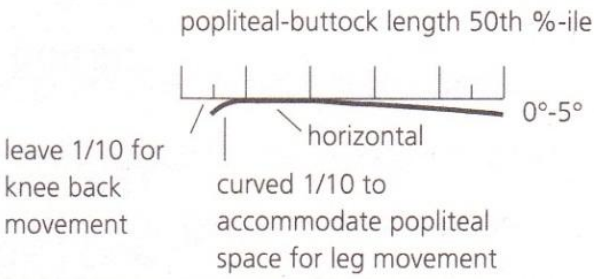

Fig 2.7: Curvatures of sitting surface.

III. METHODOLOGY

The basic parts of chair, desk and locker are added up with different parts to form two concepts of multi-utility chair. Both the concepts are similar in function with all basic parts of chair, desk and locker. In order to select the best concepts, both the concepts are drawn on a paper, to visualize the concepts, which will be easier to distinguish between them as shown in Fig 3.1 and Fig 3.2.

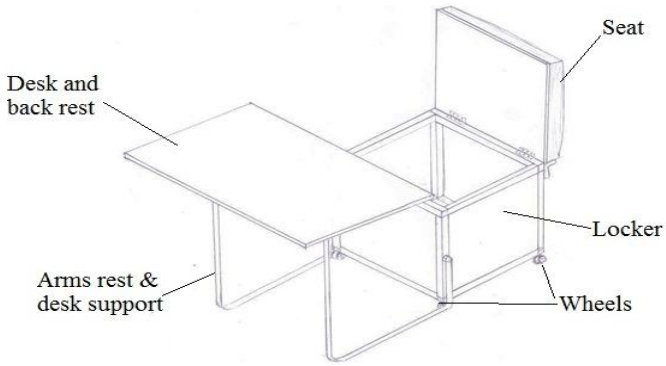

Fig 3.1: Concept A Sketch

Features of Concept A

1. Wheels
2. Locker with door on top, below seat.
3. Foldable desk which acts as both desk as well as back rest.
4. Desks stand which even acts as arms rest.

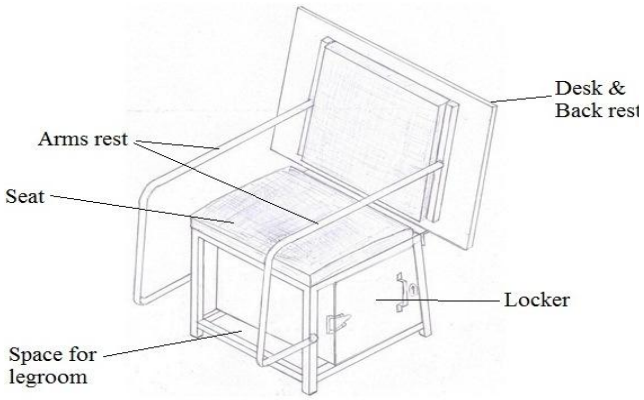

Fig 3.2: Concept B Sketch

Features of Concept B

1. Space for legroom.
2. Locker with door on side.
3. Foldable desk which acts as both desk as well as back rest.
4. Desksupport whichacts as arms rest.

CONCEPT SCREENING AND SELECTION

Two above said concepts were proposed, concept screening is done using pug matrix to arrive at a concept with more preferred features. The concept screening eliminates the concepts through rough evaluation by a six step process, which leads the team through the Concept Selection activity.The team selects a physical medium appropriate to the problem at hand. Individuals and small groups with a short list of criteria may use matrices on paper for the selection process. Enter Concepts and criteria into the matrix and select a reference model and rate its performances as '0'. The Selection criteria on which the concepts are rated are number of parts, durability, portability, ease of use, cost, reliable, year round, ease of Manufacture, safe, and appearance. Now the two concepts are compared with reference model, for the better performance than the reference model it is rated as '+'. For worse performance than the reference model concept is rated as '-' and for same performance as the reference model the concept model is rated as '0'. Sum up "better than" (+), "same as" (0), and "worse than" (-) and enter the sum for each category in the lower rows of the matrix.The net score is calculated by subtracting the number of "worse than" from the number of "better than". Once the summation is completed, the team rank-order the Concepts. Obviously, in general those Concepts with more pluses and fewer minuses are ranked higher. Often at this point the team can identify one or more criteria which seem to differentiate the Concepts. Having rated and ranked the Concepts, the team should verify that the results make sense and then consider if there are ways to combine and improve certain Concepts and the concepts with higher rank are being continued. The concept screening matrix of this project is shown in table 3.1.

Selection Criteria	CONCEPT SCREENING	
	Concept A	Concept B
Number of parts	-	+
Durability	-	+
Portability	+	-
Ease of use	-	+
Cost	-	+
Reliable, Year round	-	+
Ease of Manufacture	-	+
Safe	-	+
Appearance	0	0
Sum +'s	1	7
Sum 0's	1	1
Sum -'s	7	1
Net score	-6	6
Rank	2	1
Continue?	No	Yes

Table 3.1:Concept screening pug matrix

Once the concept is been selected, the product specifications are fixed from the ergonomic and anthropometric study. The conceptual model is then designed to actual product by using the product design specifications as constraint measurement. Since the design should not affect the comfort ability of the product.

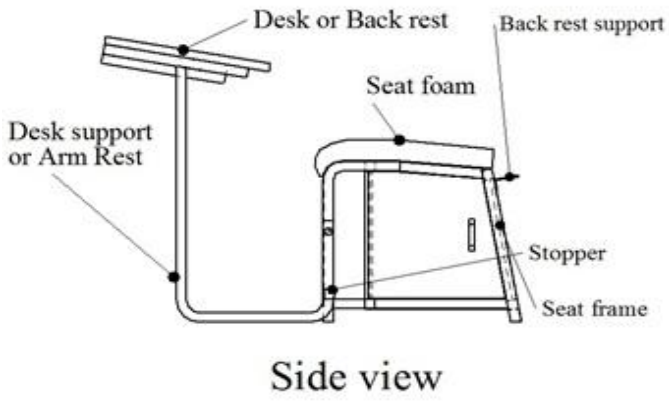

Fig 3.4:Assemble view of the multi-utility chair at Desk position

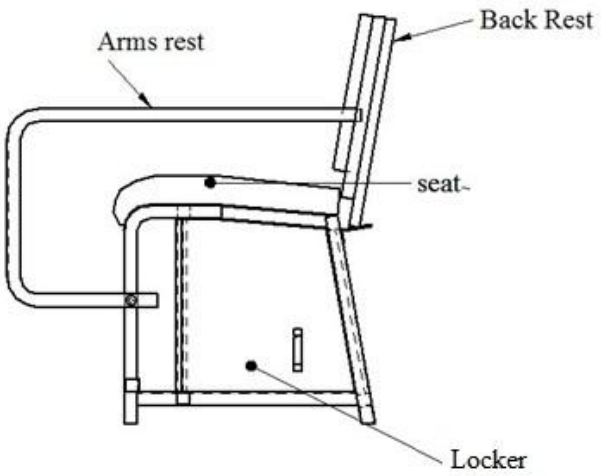

Fig 3.4: Assemble view of the multi-utility chair at chair position

The product design specifications of the multi-utility chair and basic parts of chair, desk and locker are combined to form a correct engineering design of the multi-utility chair. The chair is designed with product specifications

Before manufacturing the multi-utility chair model, for static loads exerted by the human body the stresses have been calculate for safe design. If the model fails, suitable modifications in material, size or shape has been done and the stresses in the model are checked again. On the approval of safe design the model is being fabricated through the manufacturing process like cutting, drilling, welding. Once the model is being fabricated to the engineering design the finishing processes like sandering or chip removing process is carried out, to remove the chips and get smooth surface finish.

IV. Fabricated Model

Fig 4.1 Fabricated model.

V. CONCLUSIONS

In this work, the multi-utility chair is designed, which can be used by an individual, not only as a chair, but also with desk and locker. Our multi-utility chair is has got the three combined features as indicated above. This is an excellent choice for a person seeking for three features, rather than going for three different products, he can choose our multi-utility chair integrated with three different features, it reduces the cost, the floor space and complexity of having three individual products for individual needs without compromising the original products comfort. An ergonomically good Chair and desk with locker facility is made available in this multi-Utility chair. But still in this product the chair's backrest and the desk cannot be used simultaneously, this can be considered for the scope of further improvement. Also,here the locker facility is made available below seat-rest i.e. the person no need to move to another place to lock things. For example: The blind people cannot walk often to the lockers, in that case it can be an excellent option.

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