Economical & Environmental user Friendly Adaptable Chair

P. Naveenkumar.,
M. E Assistant Professor
Hindusthan Institute of Technology, Coimbatore

Abstract:- **In the modern sportive & racing world, not only the higher professionals, but also the labors, who are all trying to lead a normal working life in an industry or some other organization, were producing their effective performance for the company so as to improve their strength in the competitive environment. The workers as well as the supervisors of a company works hard for the organization, to produce mass production & profitable income for their company. But taking a closer look at them, they work for more than**
8 hours in company without taking any rest or a seat, to get relaxed. Due to continual working culture of the company, leads to severe physical pain at joints of the workers. It leads to slow discretion of strength of the workers, may lead to severe fracture at any cause. To avoid this difficulty, a chair has to be fit with the worker permanently while working & which it should not disturb or make any discomfort to worker at any cause along with weightless feature. we designed the simple economical mechanism called, "ADAPTABLE CHAIR".

INTRODUCTION

Industries and related organizations were developing at a faster rate in many countries, hence by allotting many number of workers to make the work/job at faster rate in less time period. while working, the workers have to stand for more than 8 hours within the organization, that leads to severe physical deformities. The normal human being may not have the ability to stand for more than
8 hours as it may cause many problems later. To avoid such difficulty, the organization have to provide them some chairs & rest time at each interval. But organization could not able to provide separate time period for taking rest as it may causes decreased profitable income. To overcome this difficulty, the adaptable chair concept is emerged & designed. It does not need any particular space.
The adaptable chair concept is purely mechanism oriented design & it includes simple mechanism to operate without making any discomfort to the person using this chair.

MATERIALS & METHODS

1. *Pneumatic Air Pump*
   - The pneumatic air pump of stroke length 18.5 inch & of total height 39.3 inch can withstand a load of 120- 160 kg.

2. *Aluminum Plate*
   - Aluminum is soft, ductile, corrosion resistant & light in weight.
   - Density of Al: 2.6898 g/cm^3, Tensile strength: 90 MPa
   - Aluminum plate of thickness 0.6mm
   - Aluminum plate is used for making the required shapes for clamps and smaller linkages.

3. *Sheet Metal*
   - Sheet metal of size 2 x 2 ft^2

4. *Fasteners*
   - The bolts and nuts for linking different elements
   - The bolts used are 1/4″ & 3/8″, based on he required linkages.

5. *Velcro Tape*
   - Velcro tape used for tighten the adaptable mechanism with the human body.

DESIGN OF ELEMENTS

The elements used for connecting the links requires some design features, which is for avoiding the wear & restricting the motion of the elements while operation. Hence, it needs proper calculation for manufacturing & also for assembling purposes.
In adaptable chair, designing required for,

- Link 1 design
- "L" clamp design
- Slider link design or Link2 design
- "Z" link or Link 3 design
- DFMA for link 1 & "L" clamp

DESIGN OF LINK 1:

The link 1 is designed so as to cover the seating surface with a minimum area coverage length, for the body to seat comfortably. This link 1 has to fix in such a way that it should always possess 90-degree angle at any concern, as it is required to lift/make to expand the slider for walking & standing operation. It may be adjustable, as it may be useful for different height persons.

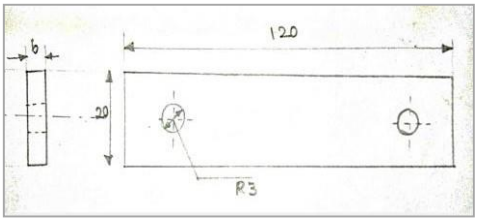


Fig. 1

Design of "L" clamp:

The "L" clamp is manufactured with respect to the rotating motion of the links connected to it. "L" clamp must be designed with a proper clearance, to avoid the obstacle while the connected link takes a rotation.

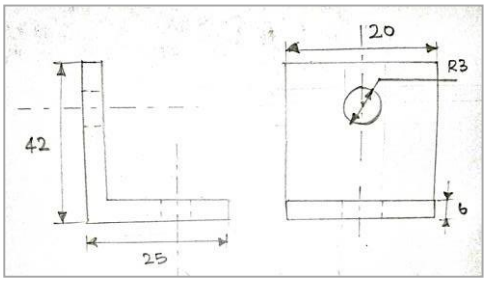


Fig. 2

Design of slider link or Link 2:

For walking & sitting, the slider plays convenient role. The slider must provide the comfortability for the user while walking & sitting.

Thus, the slider has to compress & expand frequently without any stuck in motion while walking & sitting. For this to occur, the length of expansion & minimum length comfortable for sitting have to be measured & designed.

"x" – sitting distance from ground

"x" can be adjusted to vary the height of sitting

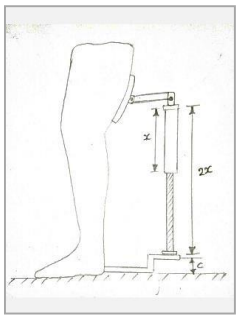


Fig. 3

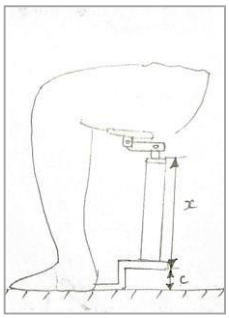


Fig. 4

Design of "Z" link or link 3:

This link is to connect the heel of human body to the chair by connecting the bottom of the shoe to the bottom of link 2. This link is bend inward so as to carry the weight in front of center of gravity of the body. A ground clearance is provided to avoid damage of the slider while compressing it at faster rate.

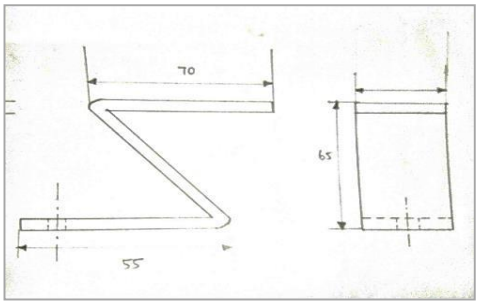


Fig. 5

The design of "Z" clamp is made with a bend element with 80-degree acute to the horizontal element. It is designed so as to make the loading force to act towards the

front of the chair & to avoid falling backwards on application of any excess intended force made by the user.

DFMA for link 1 & "L" clamp:

Design for manufacture and assembly (DFMA) for link 1 & "L" clamp is important as they are very critical when rotating action takes place at the link 1 & "L" clamp connecting point. It should have certain clearance for free motion to take place.

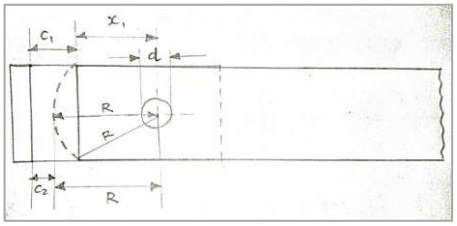


Fig. 6

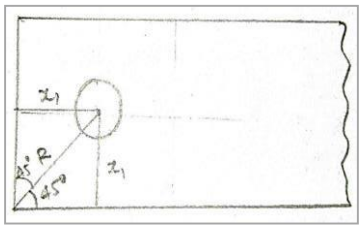


Fig. 7

For marking the drill point in "L" clamp & Link 1, design is required. Let us take,

C1 = clearance from the "L" clamp bottom to the top of link 1

x1 = distance from hole center to link 1 top

R = radius made by link 1 when it rotates around the drill axis

C2 = (assume 5mm) clearance between "L" clamp bottom & radius "R"

Drill point distance from "L" clamp = C2 + R

From fig. 4.7, Sin 45° =x1/R

R = x1/ Sin 45° = √2 * X1

CONSTRUCTION PRINCIPLE

As already explained, the adaptable chair uses the 4-bar mechanism for operation. Adaptable chair comprises of 4 links/elements in it.

- Link 1 (AB) : A- fixed point; B- rotational point
- Link 2 (BC) : B- rotational point; C- fixed point
- Link 3 (CD) : C- fixed point; D- fixed point
- Link 4 (DA) : 2 fixed point (HUMAN LEG)

Links are constructed based on the necessary force to be carried out. These links are arranged in the following locations.

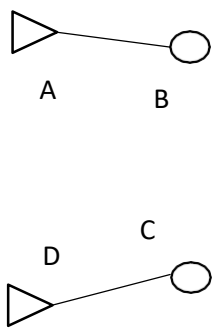


Fig. 8

- Link 1 is a normal link that connects the slider to the user's body. It was manufactured according to the seating structure design & clamping of the chair to the body.

- Link 2 was manufactured as per required functioning of the mechanism. Link 2 is the pneumatic air pump, available at low cost.

- Link 3 is the connecting element of the chair to the shoe of the user. This element is made in the shape of “Z” shape with a slight bend inward, so as to carry the load within the center of gravity of the user.

- Link 4 is the human leg, where point ‘A’ is fixed to thigh of human body & point ‘D’ is fixed to heel of the human body.

WORKING PROCEDURE

The manufactured parts are verified for the design specification & assembled at right locations. The adaptable chair is made to fit with the human leg, possessing the slider link in expandable condition. It I done so as to make compressive action smoothly while walking & sitting. The chair will perform actions on the four moves made by human action. They are,

- Leg bends forward
- Leg bends backward
- Sitting action
- Standing action

Case 1: (LEG BENDS FORWARD)

When the user wearing the adaptable chair, is taking a forward step, makes the leg to move or bend in forward or outward direction to his body. Hence, the sliding motion possess the expanded stroke for movement by extruding the stroke rod out of the cylinder.

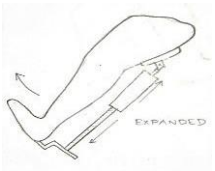


Fig. 9

Case 2: (LEG BENDS BACK WARD)

When the user is taking backward step, makes his leg to move in reverse or backward bending motion. This is adjustable by the same stroke as compressing of the stroke rod into the cylinder. As it compresses the overall length of the slider gets reduced & make comfort for waking in backward direction.

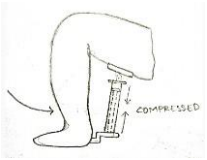
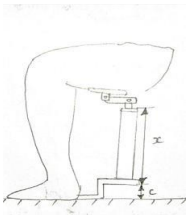


Fig. 10

Case 3: (SITTING ACTION)

When the user needs to sit, the compressive action is done by the stroke & reduces the height of the slider. The sitting height is adjustable, it may be varied for different users, just by adjusting the angle between the links 1 & 2.



case 4: (STANDING ACTION)

When the user needs to stand, the expansion stroke is produced automatically as the chair is fit to the user’s leg. The height will get increased according to the user’s wish by clamping the chair to the leg at the initial condition.

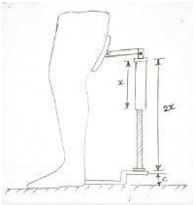
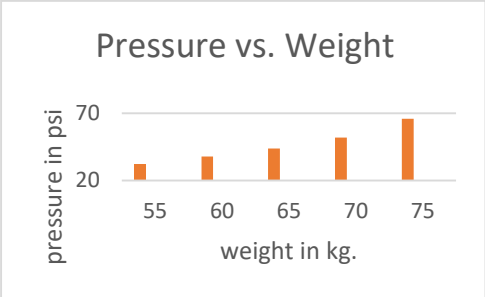


Fig. 12

RESULTS

Adaptable chair is designed and evaluated with a standard weight structure of 75 kg. it is checked with pressure vs. weight graph & the chart is displayed with three categories.

I. Sitting position
II. Standing position
III. Walking condition



Graph 1

ACKNOWLEDGEMENT

At the outset, I express my gratitude to the almighty that has been with me during each & every step that I have taken towards the completion of this project.

I thank my parents for providing ample support in achieving the good result from my project & helped me in complicated conditions.

I am thankful to the teaching & non-teaching staffs of the mechanical engineering department, especially head of the department Mr. S. R. RAJABALAYANAN, M.Tech., Ph.D., Prof. Mr. P. NAVEENKUMAR, M. E. Prof. Mr. Dixon Jim Joseph & Prof. Mr. Arunraja M. Tech., who have encouraged me & made proud of the project.

I finally thank my friends, who have encouraged & helped me in all situation to attain the project result.

CONCLUSION

The problem of physical stresses & unavailability of providing separate chair in shop floor, for taking rest, have eliminated. The adaptable chair concept enables light weight & suitable for normal walking & sitting conditions of the human being.

Therefore, the working environment will not get spoiled & along with that the regular working will be afforded by the workers by taking some temporary rest in between the working hour.

This concept will be useful not only in industries but also in supervision, quality checking, domestic purposes, trekking etc.

With pneumatic pumps & well sealing & seating, can pursue the comfortable zone for humans in the working & resting condition.

PHOTOGRAPH OF ADAPTABLE CHAIR