Design and Implementation of Chair Less Seating Arrangement for Industrial Workers and Farmers

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Abstract

In today's day to day life, it is very difficult to have free to stay relaxed while doing work. According to the research of 48% slip disk problem can occurs in workers due to only standing work. There is a need to have arrangement such that when worker get free time and during working can sit and relax. Therefore the idea of chair less chair comes in picture. It gives ability to sit anywhere and everywhere. One can easily walk or even can run with this chair, and can easily sit when get some free time. This new concept is very useful for the industrial worker, farmers, and old peoples. In this paper we will study the basic formation of this chair less seating arrangement. This paper illustrates the results followed by design consideration.
Keywords- Chair less seating, Worker Wight, Design Cylinder and Lever Arm, Load, Deflection

I. INTRODUCTION

It's an innovative concept to sit every-where with the aid of a seating chairless. The concept was first found two years ago by Keith Gunura, The Company has developed its Chairless Chair seating and entered talks with a number of manufacturers. Designed for dynamic industrial worker, the Chairless Chair aims to increase workers health and increase the production. It's like a chair, but appears whenever you need it. It's called the Chairless Seating, you wear it on your legs like an exoskeleton: working for hours by standing causes a lot of stress to human legs, but most workers get more time breaks and chairs are provided, because they take up too more space. So we thought that the best idea was to strap a flexible chair directly to you.

The device which is easier to carry, a belt secures it to the leg and it has straps that wrap the thighs. A damper engages and supports the bodyweight damper is on variable height, which is directed towards the shoes. A specially design and part of the mechanism, for works and farmer with any leg and touches the ground only when in a seating position .The ' seating chair less', which has further developed together with a Swiss startup company, is an exoskeleton that is worn on the back of the legs.

The seating chairless then locks into that mechanism, directing downwards weight to the shoes, to which it is attached it also attaches to the thighs, and also using a belt. It is an object that is available to everyone. In its different embodiments it can be humble or regal. 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.

The main aim of the proposed chair is to provide relax environment to the worker in industry as well as farmers. The organization of the paper is as follow. Section 2 describes the methodology and Design. Section 3 represents selection of material. Section 4 presents the conclusion along with future scope.

II. LITERATURE REVIEW

This was created by Zurich-based startup noonee, this Chairless Chair helps users to rest their leg muscles by directing their body weight towards a variable damper attached to the battery powered device. This chair is worn like an exoskeleton, allowing users to walk with the device while they are working. To use it, simply bend the knees to a comfortable stance to activate its damper that supports your body weight. Keith Gunura, the CEO and co-counder of noonee, told CNN that the Chairless Chair helps users maintain a good posture. "This helps to keep the back straight and can reduce the occurrence of bad postures for both healthy workers and those recovering trom muscle related injuries," said Gunura.LetsTake a look at the Chairless Chair below, which will be used in a trial in Germany, starting with BMW in September, and with Audi later this year.

III. PROBLEM STATEMENT

Past research and experiences had indicated that Slip disk problem and leg pain occurs in worker, farmer, old person, due to standing position. This may increase the development fatigue as well as it reduces the productivity. This may lead to decrease the efficiency of the person.

IV. OBJECTIVES

1) Study the basic chair and different mode of failure in chair.
2) Design the chair as per specification and model in analyze it in ANSYS software
3) Study the different material and recommend the best alternative material for chair less chair with stress and Wight
4) The Main objective of our project is worker can move freely and seat anywhere without any stress and pain

V. METHODOLOGY

As we have known the chair is needed by the people who undergo fatigue due to standing for large time. For this the system is designed using the software like solid work, force, pressure, stress calculation ware done.

The experimentation is done by using different load in various directions. The analysis is done with ANSYS software. In which first meshing is done. The boundary condition are set according to the observation and load are applied according. The validation of result by the ansys is done by the experiment

MS links selected as per the guidelines such that the links between the waists to knee is of 400 mm and the knee to ankle is 450 mm which is standard size for people. The MS hollow square pipe available in the market of mostly two sizes of thickness one is 2 mm and 4 mm thick.

VI. MATERIAL SELECTION

The selection of material for different part of a machine is the in the fabrication of machine. For a design it is must that he is familiar with the effect, which the manufacturing process and welding treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following of the materials, Suitability of materials for the working condition in service, The cost of materials, Physical and chemical properties of material, Mechanical properties of material.
Material used for making chair less seating is tabulated bellow:

- CYLINDER 32 BORE Diam. And pressure 0.1to 1.5MPA are 2
- Pad Material is MS and Quantity are 2
- Nut Bolt M-8 Material is MS and Quantity are 18
- Nut Bolt M-6 Material MS and Quantity are 4
- Hollow square pipe Material is MS and Quantity are2
- Shoes Holder material is MS and Quantity are 2
- Shoes Quantity 1

Fig. 1: Experimental setup of Chair less seating

VII. DESIGN

Square hollow pipe of MS is selected, as sectional modulus of Square section is more shown in General purpose for machining, suitable for lightly Wight and light stressed components including bolts , rounds, clips, studs, etc. welding ability is require can be case harden to increases wear resistance, available in curve rounds, squares and flats , and hot rolled round. MS is readily available in quantity and is minimum cost, it has better resistance to dust, fumes, it has rugged construction

Shoe holder is used for attachment of worker shoes with seating chair less. It facilitated for easily walking with chair. It is fixed with the help of nut bolt with shoe holder.

Fig. 2: Shoes Holder

Here a small C channel one end of which is joint to shoes and another end is fixed to the bottom Piston connecting rod.
Consider worker weight on seating chair M=120kg
W=Mg ($9.81 m/s^2$)
= 120 * 9.81
=1177.2N
Worker weight divided equally 60Kg/leg

A. Design of Bolt
Consider no. of bolt N= 2
Primary force $F_P = \frac{W}{N}$
W= 588.6 N
W= Worker Wight
We = W*($l_1^2+l_2^2$)
l=20mm
secondary force Fs = 2.501*10^3
Resultant force on bolt = $\sqrt{Fp^2 + Fs^2}$
Fr = 20517*10^3
Consider FOS=1.2
Allowable stresses produce in MS

$$\tau = \frac{0.5 * Sut}{FOS}$$

Allowable Stress τ = 104.16 MPa
$\tau = \frac{Fr}{Area}$
core diam. of bolt Dc =5.546mm
D=1.19Dc
D=6.6 mm
Select standard M8 bolt selected

B. Welded Joint
Force P=588.6 N
Shear stress τ = 104.5MPa
P= 1.414*h*l*τ
h= 0.1138mm
$\sigma_t = \frac{P}{0.707*h*l}$
σ_t = 209.02 MPa

C. Selection of Cylinder
Select double acting cylinder from JELPC Company select 32mm bore diameter

Calculate pressure on cylinder

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Pressure} = \frac{588.6}{\frac{\pi * 32^2}{4}}$$

Pressure on Cylinder 0.7371 N/mm^2
Thickness of Cylinder

$$\text{Thickness} = \frac{\text{pressure} * \text{Diam.}}{2 * \text{Tensile stress}}$$

YieldStrength of MS 240N/mm^2&ultimate strength is 400N/mm$^{2.}$
Pressure = 0.747 N/mm^2
S_{ut}=400 N/mm^2
Consider FOS 1.2

$$\text{Permissible Stress} = (\frac{\text{Ultimate Strentgh}}{\text{FOS}})$$

t = 0.425mm
Standard cylinder thickness 4mm our value is min of 3mm. Hence design is safe
$D_o = D_i+2t$
= 32+2*4
=40mm

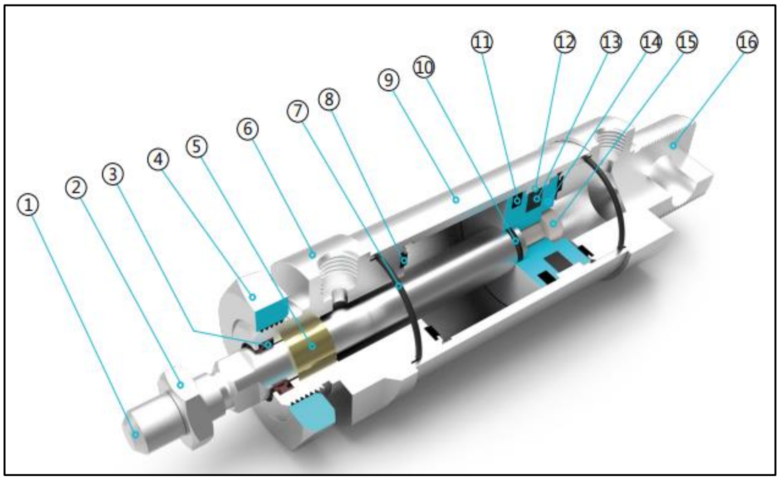

Fig. 3: Cylinder Internal Structure

Number	*Name*	*Number*	*Name*
1	*Piston rod*	*9*	*Barrel*
2	*Hexagon nut*	*10*	*O ring*
3	*Shaft seal*	*11*	*Piston seal*
4	*Hexagon nut*	*12*	*Anti-friction seal*
5	*DU bearing*	*13*	*Magnet*
6	*Front cover*	*14*	*Piston*
7	*O ring*	*15*	*Socket head cap screw*
8	*Anti-collision gasket*	*16*	*Back cover*

D. Lever Design

Bending stress of MS σ_b = 150 N/mm^2
t= Arm Thickness (mm)
b=Arm Width (mm) 4.5*t
Moment about center 30mm from center of shaft
W=60kg =588.6kg/leg
M=W*L
M= 588.6*30
M=17.658*10^{3}Nmm
Bending Equation

$$\sigma = \frac{\text{M}}{\text{Z}} z = \frac{bt^2}{6}$$

$$150 = \left(\frac{17.658 * 10^3}{\frac{4.5 * t * t^2}{6}}\right)$$

t= 5.3 =6mm
Lever Arm Dimension 18*6

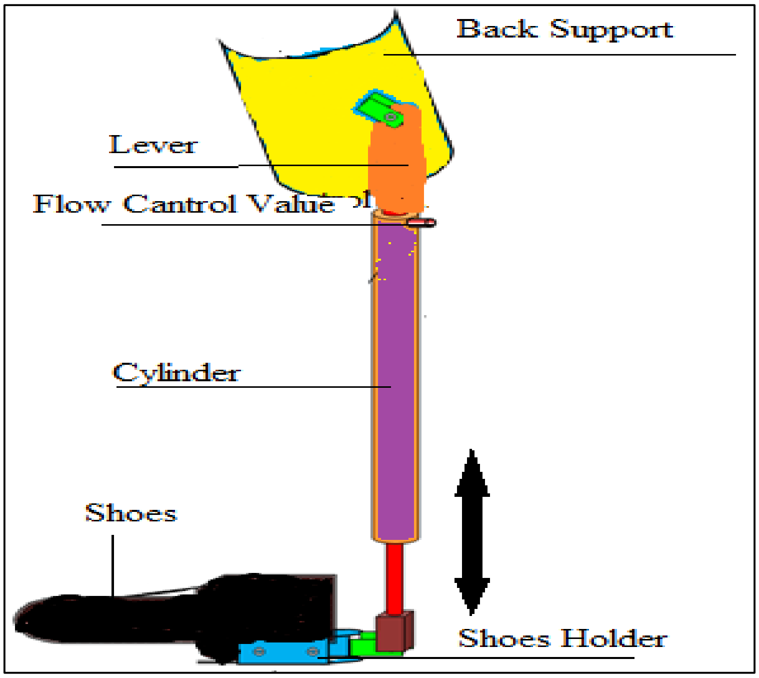

Fig. 4: Proposed System

The use 2 cylinder has 100mm stroke length 32 mm bore diameter, and is provided with 2 FC valves. The leg holder which will hold the back holder and is made by taking 2mm MS sheet bended to the shape of back . 4 nylon laces have been fixed to the back holder with the help of lever arm so that it can hold the leg. The leg holder is fixingto square block and other end is fixed to. Used M-8 nut bolts for all joint.

The objective of the seating chairless is too able to the worker or farmer to have the move around with ease, with the use of a seating chairless.

Fig. 5: Model

VIII. RESULTS

The simulated values of deflection and stress for with load and without load are presented. The experimental results were recorded and shown below

Fig. 6: Test Setup

Table1: Maximum and minimum stress and strain in sitting posture

Parameter	Max Value	Min Value
Von Misses Stress (N/mm^2)	138.51	25.13e-6
Maximum Shear Stress (N/mm^2)	77.3	12.25e-6
Equivalent Elastic strain	1.4e-9	2.8e-16
Total Deformation(mm)	6.03	0

Fig. 7: load of 120kg easily seat on chair

IX. FEATURES OF THE PROJECT

1) A variable damper engages and supports the worker bodyweight, which is directed downward to the shoes.
2) Any works use with any footwear and touches the ground only when in seating position.
3) The user just moves into back side mechanism is converted is chair form
4) Pneumatic cylinder is used for smooth working which make easy to operator
5) By using Carbon rods or aluminum the weight of the mechanism weight can be further minimum

X. CONCLUSION

At high load the system failure was not form. The system was comfortable for the people using it. The cost of the system is decrees due to adequate material and strengthens to the system. The maximum stress and deflection within limit.

The chair is designed in such a way that worker can walk and stand easily. When adjusted height of chair, you can fill comfortably relax with all worker weight.

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