Design and Fabrication of Exoskeleton Chair

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Abstract— One issue looked by dynamic specialists is restricted seating offices particularly in open transportation where they need to remain as they are doing their exercises for extensive stretches of time. In industry, the restricted workspace makes it incomprehensible for administrators to utilize seats, so administrators need to represent significant stretches while working the machine. This investigation means to plan a chairless chair by using segments that are modest and simple to get on the lookout. In this plan, a few variations have been made which are then looked at by surveying their volume, mass, creation expenses and solace levels, with the goal that the best plan variations for prototyping are gotten. In light of the consequences of the exploration, an agreeable, protected to utilize chairless chair was created with neighborhood parts. The aftereffects of this study become a reference for additional turn of events.

Keywords: Exoskeleton Chair

I. Introduction

In the present testing world, man and machine share an impartial space at work, some working conditions include endeavors of standing hours all through the day, for such exercises the weakness increments consequently diminishing the usefulness. Machines can work at their best without rest, they don't get drained and weariness, yet for people, the necessities and solaces plays a crucial job, it is presently an ideal opportunity to embrace improved and planned machines, instruments and standards which gives straightforward entry to our expectations for everyday comforts, to unpretentious the prerequisite of specialist, to give quick seating office, seats are not provided in floor space or studio, then, at that point it's an ideal opportunity to think unique and utilize a seat less seat which involves less space, size and light in weight. 'Exoskeleton' is stand-out, comes in reduced, agreeable and wearable basic mechanical gadget which gives human prosthetic lower appendage support.

II. Scope of Project

In this work a mechanical ergonomic instrument that is planned around the shape and capacity of the human body, with portions and joints comparing to those of the individual, it is remotely combined with. It capacities as a seat at whatever point it is required; this machine component is industrially called as 'Chairless chair '.

III. Design Methodology

Procedure of this work is focused on the advancement of chair-less seat to help human body part which is a wearable Gadget particularly modern laborers need to represent quite a while around 10-12hrs per day. The gadget comprises a casing to Embraces the rear of the specialists leg and it has a belt to keep away from slip. Laborers can stand and walk like ordinary, yet when they need to sit pressing a catch secures the edge set up at the ideal point. So the heaviness of the body is moved through the edge to the floor or the heels. Each component of chair-less kinematically analised to ensure its smooth movement.

A. *Upper leg-*

Its length is 420mm and strut is connected to it at a length of 200mm. The inner and outer diameters are 17mm and 42mm respectively.

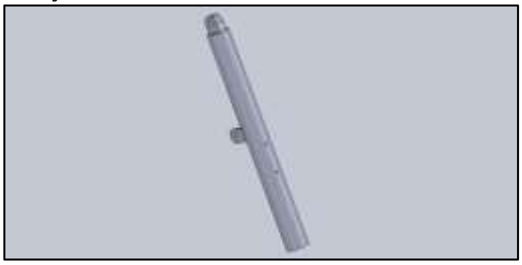


Fig. 1: Upper Leg

B. *Lower leg-*

Its length is 430mm and strut is connected to it at a length of 157.78 mm. The inner and outer diameters are 5.5mm and 22.31mm respectively.

Fig. 2: Lower Leg

C. *Gas strut-*

Its total weight bearing capacity is 120 KN. The inner and outer diameters are 6mm and15mm respectively. It is connected to both the components upper leg and lower leg. It helps in balancing the counter weight.

Fig. 3: Gas Strut

D. *Height adjuster-*

Its length is 100mm and is the lowermost part which is attached to shoes. It helps in adjusting the overall height of chairless chair.

Fig. 4: Height Adjuster

E. Thigh supporter-

It is uppermost part of chairless chair.

Fig. 5: Thigh Supporter

F. PIN-

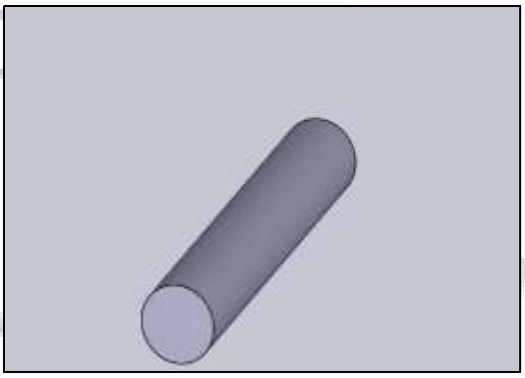


Fig. 6: Pin

IV. CALCULATION OF UPPER LEG: -

Selecting diagram of hollow circular road under point load

$\sigma_{max.} = \frac{M(\max.)}{S}$

$= \frac{\text{Mmax.}}{\frac{\pi(D^4-d^4)}{32D}}$

Where

$M_{max.}$= Maximum bending moment

S= section modulus

D= outer diameter

d= inside diameter

$\sigma_{adm.}$= maximum admissible (acceptable) stress

From equation no. 1

$$\frac{\pi(D^4-d^4)}{32D} \geq \frac{M_{max.}}{\sigma_{adm.}}$$

$\{let\ factor\ of\ safety\ = 4,\ yield\ strength = 125MPa\}$

$\sigma_{adm.} = \frac{\textbf{yield strength}}{\textbf{F.O.S.}}$

$= \frac{125}{4}$ =31.25 N/mm^2

$M_{max.}$= -1000*220

=-220000 N mm

For solid shaft

Z or S=$\frac{\pi}{32}D^3$ mm^3

To calculate shaft diameter under 1000 N point load

$$\frac{\pi}{32}D^3 = \frac{M_{max.}}{\sigma_{adm.}}$$

$$D^3 = \frac{220000*32}{31.25*\pi}$$

= 41.55 mm

[D= 42 mm]

Now,

$$\frac{\pi(D^4-d^4)}{32D} \geq \frac{M_{max.}}{\sigma_{adm.}}$$

$3111696 - d^4 = 3013299.36$

$-d^4 \geq -98396.64$

$d \leq 17.71$ mm =17 mm

[d = 17mm]

Now deflection:-

$$\text{Deflection} = \frac{FL^3}{3EI}$$

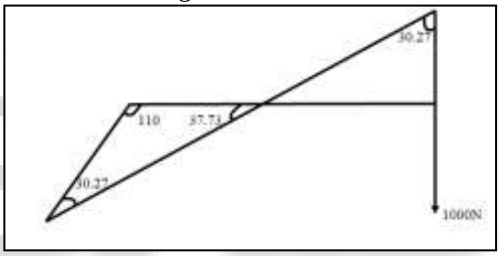
$$= \frac{1000*220^3}{3*7000*\frac{\pi}{32}(42^4-17^4)}$$

= 0.1706 mm

SO

Deflection $_{max.}$ = 0.17mm

Calculation for lower leg: -



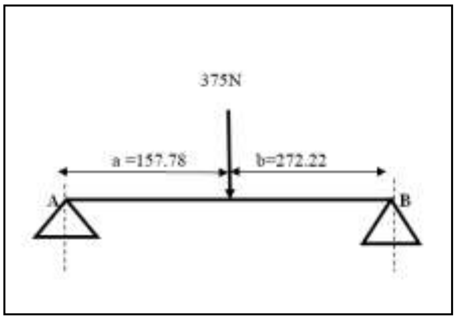
X=1000CosΘ-120

X = 743.65

xSinα = 743.65*Sin30.27

= 374.9

= 375N



R_a*430 = 375*157.68

R_a = 137.51 N

R_a*R_b = 375

R_b = 375-137.51

R_b = 237.40

M_a = 0

M_b = 0

M_c = 375*157.68

= 59167.5 N mm

$M_{max.} = \frac{Fab}{L}$

where b=L-a = 272.22mm

$$= \frac{375*157.68*272.22}{430}$$

$$= 37433.41 \text{ N mm}$$

For solid shaft:-

$$\frac{\pi}{32} D^3 = \frac{37433.41}{31.25}$$

[D = 22.31 mm]

For hollow shaft:-

$$\frac{\pi}{32} \left(\frac{23^4 - d^4}{23}\right) = 1197.869$$

[d= 5.5 mm]

For deflection:-

$$\text{Deflection}_{max.} = \frac{Fa(L^2-a^2)^{\frac{3}{2}}}{(9\sqrt{3})*LEI}$$

$$= 0.198 \text{ mm}$$

So

$$\text{Deflection}_{max.} = 0.198 \text{ mm}$$

V. 3D MODEL

The 3D diagram designed in SolidWorks.

A. Isometric View: -

Fig. 7: isometric view of chair

B. Front View: -

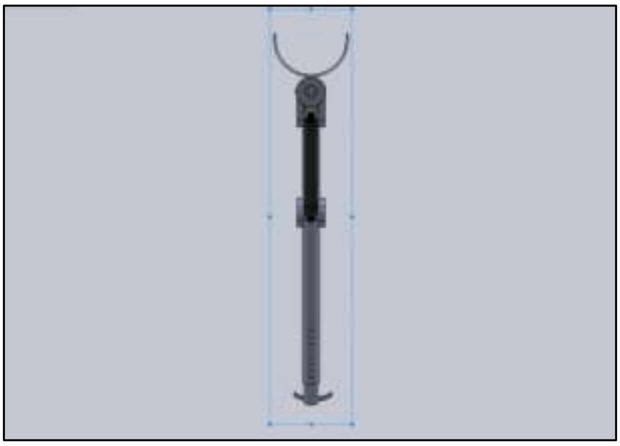


Fig. 8: front view of chair

C. Side View: -

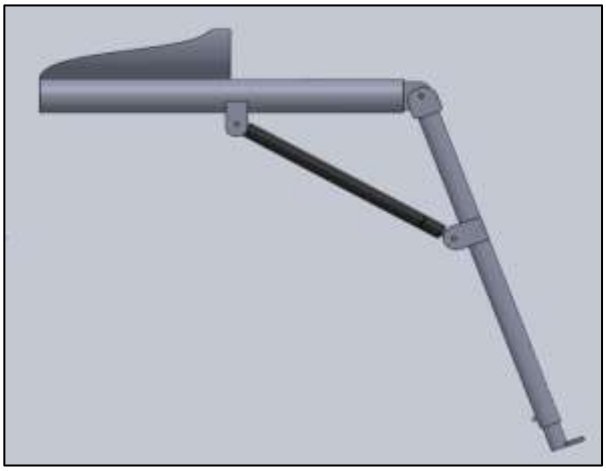


Fig. 9: side view of chair

D. Top View: -

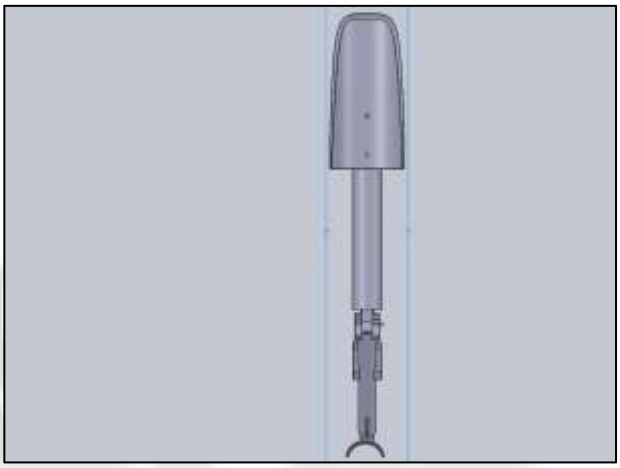


Fig. 10: top view of chair

VI. CONCLUSION

The exploration and configuration have been done on the chairless chair, to decrease the exhaustion due to persistent work. Some of the shortcomings of the chairless seat item model created, which is the heaviness of the Chairless chair is excessively hefty, causes the client not to have the option to walk regularly and can as it were to walk gradually. Stride expansion in the leg segment which is a proper joint makes the user's leg Become hardened in light of the fact that the leg can't move openly. This outcome is a reference for the turn of events of chairless seat items that are more reasonable for laborers in particularly some areas. Identifying with the heaviness of the chairless seat, adaptability to move, security, solace in its utilization and Low creation costs.

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