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Mechanical Assistance Chair

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Abstract:*This chair is based on Ergonomics principle. The science of design of equipment is to reduce operator fatigue,discomfort and injury. This helps the caregiver avoid heavy lifting situations that put their back at risk of injury. The device can be converted into a chair and the wheels of the device provide mobility like a wheel-chair . It is very aptly called the 'Mechanical assistance chair' because of what is does and even though it was originally created with able-bodied mechanics in mind (who get down on their backs a lot; hoping to save them pain down the line).With the flick of a switch, this machine goes from "sitting mode" to "creeper mode".*
Keywords: *Creeper, Design, Electro-linear, Ergonomics, Mobility aid*

I. Introduction

This project is about manufacturing of chair for car mechanic and uniquely design for lifting, lowering and reclining .This chair is mechanical, robotic, fully automated and adjustable. Four caster wheels are provided for full mobility. Designed to support shop workers in any position while at work for better productivity and overall. Adjustable control arms provided for simple handling.

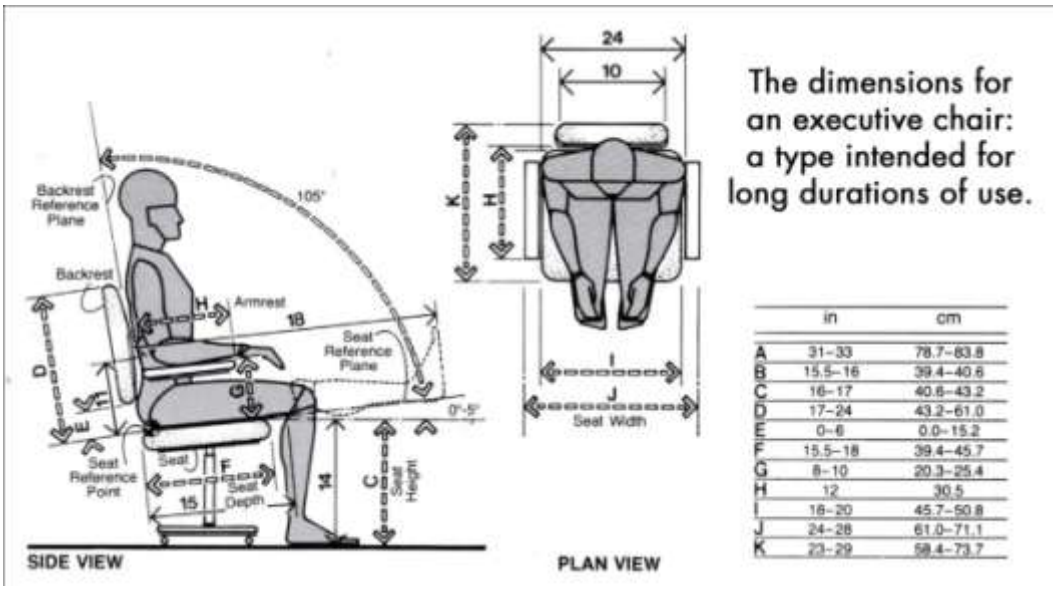
This chair is not manufactured yet in India. By providing some modification and changing design and material of the chair we can reduce the cost, so that it can be available in cheap cost. We are adding some another features like tools compartment and adjustable torch for working in dark places underneath of car

Literature Review:

1.Safar Abdul Razack[1], Rashid Ahmed K.[2], Vishnu Prasad K.V.[3] all has done research work on Design And Fabrication of Pneumatically Powered Wheel Chair- Stretcher Device-This paper presents the design and fabrication of pneumatically powered stricture chair convertible device with movable support segments in an attempt to help such patient and caregivers.(4), 10 October 2015. 10278-10289.

2.Aniket tiwari[1], Mangesh Chopde[2], Prashant Bagde[3], Praveen Kale[4], Bhagvat Shinde[5] all has done his research work on Design and Development o Human Hoist-The study will include the ergonomis risk factors in relation of human and their nature o work. With the flick of a switch, this machine goes from "sitting mode" to "creeper mode". (3), 1 October 2013. 2319-1058.

II. Chair Design And Dimensions.



	in	cm
A	31–33	78.7–83.8
B	15.5–16	39.4–40.6
C	16–17	40.6–43.2
D	17–24	43.2–61.0
E	0–6	0.0–15.2
F	15.5–18	39.4–45.7
G	8–10	20.3–25.4
H	12	30.5
I	18–20	45.7–50.8
J	24–28	61.0–71.1
K	23–29	58.4–73.7

Fig-Anthropometric

The chair dimensions are directly taken from anthropometry, such as sitting eye height, sitting height, sitting elbow height, Thigh clearance , knee height, elbow to elbow breadth, hip breadth, sitting shoulder height, forearm figure tip length, buttock-popliteal length etc.

III. Chair Parts

Caster Wheel

A **caster** (also **castor** according to some dictionaries) is a wheeled device typically mounted to a larger object that enables relatively easy rolling movement of the object. **Casters** are essentially special housings that include a **wheel**, facilitating the installation of **wheels** on objects.

Material-Mild Steel

Mechanical Properties	**Metric**	**Imperial**
Tensile Strength, Yield	370 MPa	53700 psi
Elongation at Break (In 50 mm)	15.0 %	15.0 %
Reduction of Area	40.0 %	40.0 %
Modulus of Elasticity (Typical for steel)	205 GPa	29700 ksi

Steel is consisting of carbon and iron, in which iron is more than carbon. In fact, most of steel can have 2.1 percentage carbon. Mild steel is one of the most commonly used construction materials. It is very strong and can be made from readily available natural materials. It is called as mild steel because of its comparatively low carbon content.

Physical Property

Mild steel is very strong due to the low amount of carbon it contains. In materials science, strength is a complicated term. Mild steel has a high resistance to breakage. Mild steel, as opposed to higher carbon steels, is quite malleable, even when cold. This means it has high tensile and impact strength. Higher carbon steels usually shatter or crack under stress, while mild steel bends or deforms.

Usability

Mild steel is used for construction, because it has good weld ability and machinability. Because of its high strength and malleability, it is quite soft. This means that it can be easily machined compared to harder steels. It is also easy to weld, both to itself and to other types of steel. It takes on a nice finish and is publishable. However, it cannot be hardened through heat treatment processes, as higher carbon steels can. This is not entirely a bad thing, because harder steels are not as strong, making them a poor choice for construction projects.

Actuators

Linear Actuators creates motion in a straight line. These actuators are used in machine tools as well as in industrial machineries and in computer devices like disk drives and printers, in valves and dampers, and in many other places where linear motion is required. Hydraulic Cylinders or Pneumatic Cylinders both are produces linear motion other mechanisms are also used to provide a linear motion from a rotating motor.

Selection of Actuator

1.Force requirement

Coefficient of friction (μ)=0.6 (for ms to ms connection)

F= μ×Rn×(X2) …….(for both side connection)

F=friction force/force required to move

Rn=normal reaction

W= total weight of person (w1) + weight of assembly/tools(w2)

W=100+30

W=130kg

Load on single wheel=$\frac{130}{4}$

=32.5kg/318.8N

F=0.6×318.8×2

=382.59N ……..(1)

Electro-Mechanical Actuators-:

Lead nut is part of the motor in miniature electro-mechanical linear actuator. The lead screw does not rotate, so as the lead nut is rotated by the motor, the lead screw is extended or retracted. Electro-mechanical actuators are work same as mechanical actuators instead of the control knob or handle is change with an electric motor. Rotary motion of the motor is converted to linear displacement of the actuator. There are many designs of modern linear actuators are present in various companies and the company that manufactures them tends to have their own methods.

Motor

Type-Stepper motor-A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. Applied pulses of motor are directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied.

Microcontroller

The Arduino Uno microcontroller board is based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It consists of everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. It is different from all conventional boards such that it does not use the FTDIUSB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

Bearing

Bearings such as Pillow block bearings, flange bearing units, bearing blocks, and take-up bearings units are consist of housing with a bearing mounted in it. They are available in a variety of materials, mounting configurations and various bearing features. Each and every mounted unit, include a mounted bearing, works as a system to position the bearing safely for reliable operation. Read more about each type of pillow block bearing using the links below.

Structure of Square Bar

Cross Section of Structure Bar:-

Weight=110kg

=110×9.81

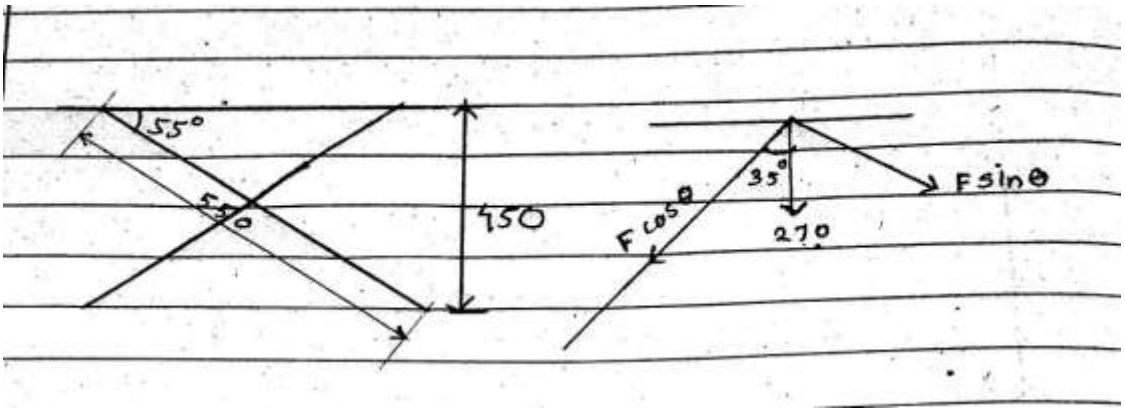
=1079.1N

Load on eachbar

(No. of bar 4)=1079.1÷4

=269.775N

=270N



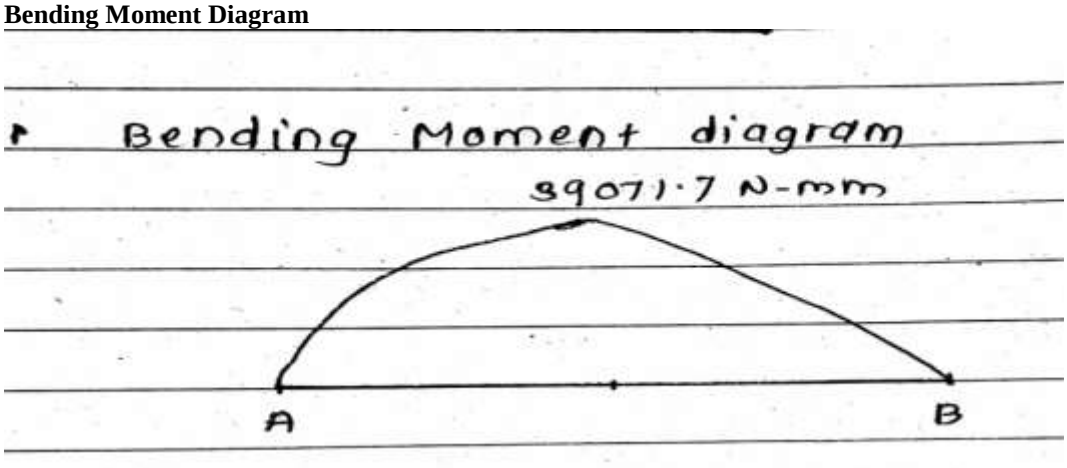
270cos35 = 221.17N
Working stress= F÷A=SYT÷FOS
=340÷2
=170
170=221.17÷Area
Area=1.301mm^2
Selecting bar=25×25×2.6mm (square tube)
Area=2.16×10^2 mm^2
Selected bar area>working area

Radius of gyration for square tube section:-
R=aa=25 b=20

$$r = \frac{\sqrt{a^2} + \sqrt{b^2}}{\sqrt{12}}$$

=9.24mm

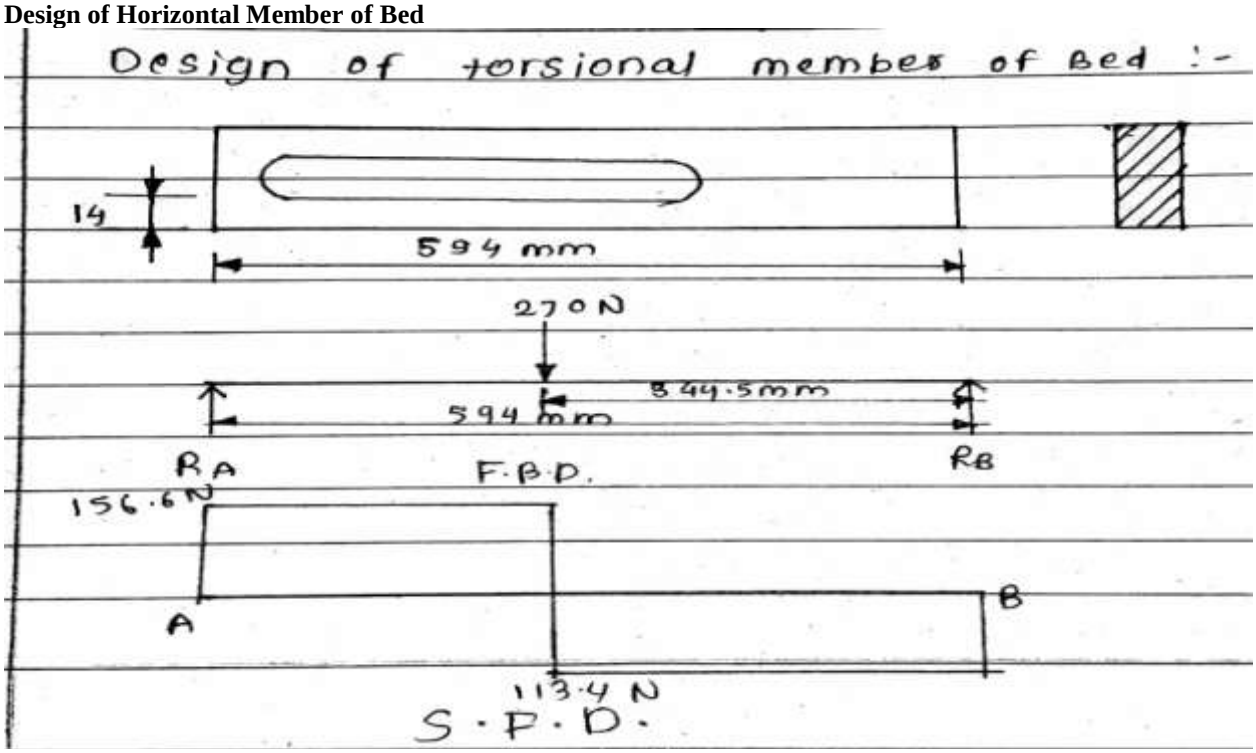
Bending Moment Diagram



Max bending moment=39071.7Nmm
I=BD^3/12
=3×40^3/12
=16000mm^4
Y=20
M/I=σ/y
3907.7/60000=J/20
M/I=σ/y
3907.7/60000=J/20
Since σ=48.83 N/mm^2 ……is less than working stress (170mpa)[for mild steel]
Critical load for buckling (Pc) =a× σy{(1- $\frac{\sigma y}{4\pi^2 nE}$(l/r)^2 ……(ddb page 68)
=2.16×10^2×340[1-(340/4π^2×2×210×10^3)×(555/9.24)^2]

=68006.9N>>270N
Therefore structural bar is safe in buckling

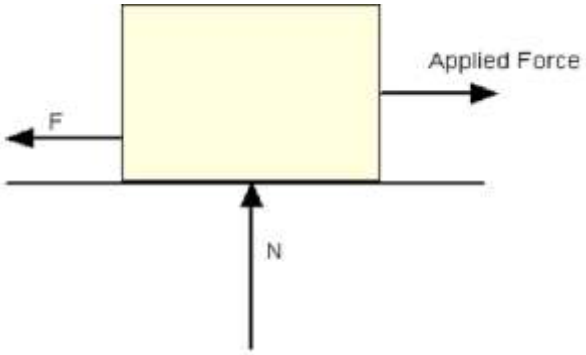
Structure Of Bed
Design of Horizontal Member of Bed



Ra + Rb =270N ……..(1)
Ra×594-270×(344.5)=0
Ra=156.6N
Rb=113.4N

The friction force is the force exerted by a surface when an object moves across it - or makes an effort to move across it.
The frictional force can be expressed as
$F_f = \mu N$…… (1)
Where,
F_f = frictional force (N, lb)
μ = static (μ_s) or kinetic (μ_k) frictional coefficient
N = normal force between the surfaces (N, lb*)*
There are at least two types of friction forces

- kinetic (sliding) friction force- when an object moves
- static friction force - when an object makes an effort to move



For an object pulled or pushed horizontally the normal force - *N* - is simply the gravity force - or weight:

$N = F_g$

$= m g$ …… (2)

Where,

F_g = gravity force - or weight (N, lb)

m = mass of object (kg, slugs)

g = acceleration of gravity (9.81 m/s^2, 32 ft/s^2)

The friction force due to gravity *(1)* can with *(2)* be modified to

$F_f = \mu m g$ ..... (3)

IV. Conclusion:

The chair to creeper conversion feature of this device makes mechanic work easier. The comfort, safety and functional independence of our growing elderly population might be dramatically improved with better sitting design The first improvement suggested is the use of electronic systems to perfectly synchronizethe motion of head and foot section during a conversion.

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