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Power Assisted Two-Wheeler Centre Stand Mechanism

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ABSTRACT: Most bikes come with both a side stand/kickstand and a centre stand. The kickstand is easily deployed allowing the bikes to lean to the left side, whereas the bike must be hoisted up onto the centre stand. Unless on firm, level ground, a kickstand cannot be trusted, and although the centre stand overcomes this problem, the difficulty with it is that it needs to be stepped upon and the vehicle needs to be lifted manually. This is not an easy task for most females and elderly people. In this paper, an automated centre stand is designed and tested which uses linear actuators powered by pneumatics to lower the stand and lift the vehicle. This stand reduces human effort, in comparison to the traditional centre stand/kickstand design.

KEYWORDS: Pneumatic, Centre Stand, Kickstand, Pneumatic Actuator, Two Wheeler, Power Assisted, Automation.

I. INTRODUCTION

A kickstand is a device on a bicycle or motorcycle that allows the bike to be kept upright without leaning against another object. It is usually a piece of metal that flips down from the frame and makes contact with the ground. It is generally located in the middle of the bike or towards the rear.

A centre stand is a pair of legs or a bracket that flips straight down and lifts one wheel off the ground. Many motorcycles feature centre stands in addition to side stands.

II. PROBLEM STATEMENT

To design and develop an easier, automated system for the application of centre stand in two wheelers.

III. SCOPE

According to surveys, around 70% males and 30% females drive two wheelers^[3]. Among those 70% males, around 30% are the elderly. Most of the females and elderly people find it difficult to apply the centre stand and hence there is a need to develop an easier and automated system.

The following are the advantages of a centre stand over a side stand.

1. Centre stand takes the load off the tyres for long term parking.
2. Centre stand reduces the amount of parking space required by the vehicle.
3. Centre stand is used in order to kick start the vehicle in case of electrical failure.

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IV. METHODOLOGY

The following design methodology was followed:

1. Study of the components and the functioning of the existing centre stand mechanism.
2. Determining an alternative system for the application of the centre stand.
3. Synthesis of the mechanism using selected system.
4. Analysis of the loading conditions on the conventional stand, and using this as the design parameters for further system calculations.
5. FEA and simulation of various components using ANSYS, FluidSIM.
6. Fabrication or procurement of the components.
7. Assembly and testing.

V. VEHICLE SPECIFICATIONS

Following are the specifications of the vehicle we have chosen^[4].

Make	:	Honda
Model	:	Activa
Dry Mass:	111 kg	
Wet Mass	:	115 kg (5.3 litre fuel capacity, equalling 4 kg of fuel)
Conventional Stand Height	:	200 mm
Ground Clearance	:	169 mm
Clearance at stand mount	:	175 mm

VI. SELECTION OF SYSTEM

We compared Pneumatic, Hydraulic, and Electric systems^[5].

Pneumatic system was finalized, due to bulkiness of hydraulic system and more power requirement of electric system.

VII. PRELIMINARY DESIGN

STEP 1 – The stand assembly is initially in horizontal position.

STEP 2 – The user first swings the stand into vertical position.

STEP 3 – The user then operates the DCV, which in turn extends the actuator downwards, thereby lifting the vehicle.

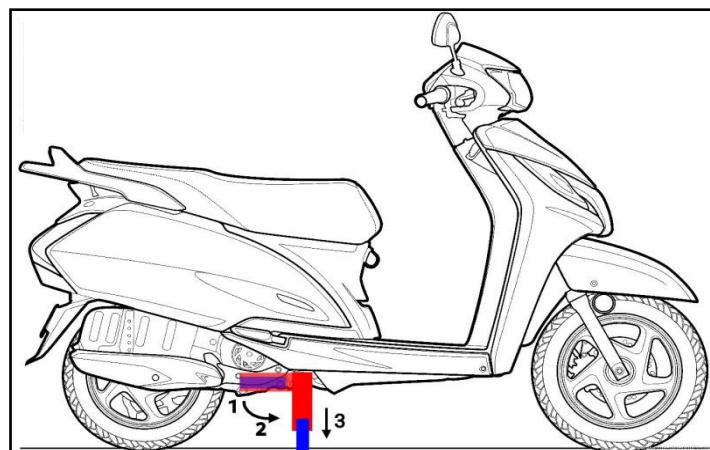


Fig.1: Schematic of proposed design.

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VIII. SYNTHESIS OF MECHANISM

After analysis we synthesized a **Pneumatic Parallel Synchronizing Circuit**^[6] as follows.

- | | | |
|-----------------------------|---|--|
| 1. Air Compressor | - | 1 |
| 2. Direction Control Valves | - | 1 (4/3 manually operated) |
| 3. Flow Control Valves | - | 2 (for each actuator extension stroke) |
| 4. Pneumatic Actuators | - | 2 (double acting, air actuated) |

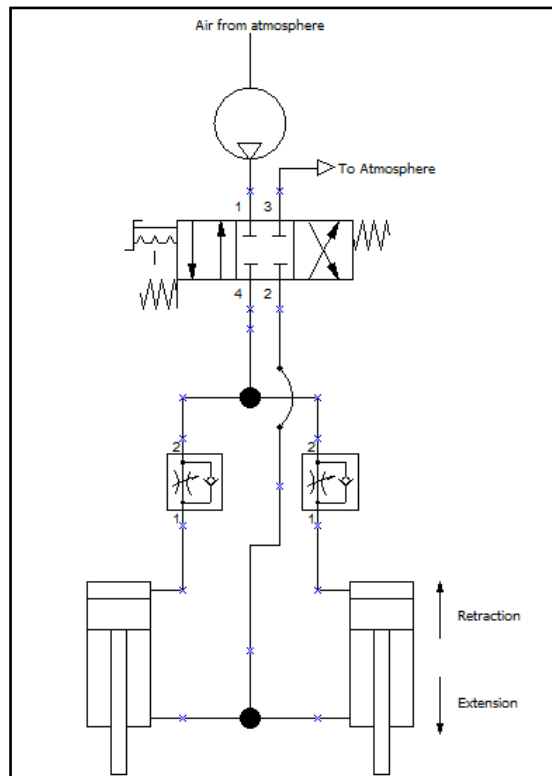


Fig. 2: Pneumatic Circuit

IX. CALCULATIONS

Since a clearance of 175 mm is available at the stand mount, rigid length of new stand must be less than 175 mm in order to account for ground undulations.

From manufacturer's catalogue, we find the actuator length to be 150 mm.

Thus ground clearance after stand is in upright position will be $175 - 150 = 25$ mm.

Stroke = Stand height – rigid length = $200 - 150 = 50$ mm

1. Total weight to be lifted:

Total vehicle mass	=	115 kg
Considering 5 kg of miscellaneous mass, total mass	=	120 kg
Total Weight (F_c)	=	$120 \times 9.81 = 1177.2$ N

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2. Total weight to be sustained:

Considering a person of mass 80 kg sitting on the vehicle after application of stand,

$$\text{Total mass} = 120 + 80 = 200 \text{ kg}$$

$$\text{Total weight (F)} = 200 \times 9.81 = \mathbf{1962 \text{ N}}$$

1. From manufacturer's catalogue considering standard diameter of actuator^[7]

$$D = 32\text{mm} \quad d = 12\text{mm}$$

$$\text{Area} = \frac{\pi}{4} \times D^2 = \frac{\pi}{4} \times 0.032^2 = \mathbf{8.0424 \times 10^{-4} \text{ m}^2}$$

Since we are employing two actuators, area will be doubled

$$A = \mathbf{16.0848 \times 10^{-4} \text{ m}^2}$$

2. Pressure:

a. To be generated by the compressor:

$$P_c = \frac{F_c}{A} = \frac{1177.2}{16.0848 \times 10^{-4}} = \mathbf{7.32 \text{ bar}}$$

b. To be sustained by the assembly:

$$P = \frac{F}{A} = \frac{1962}{16.0848 \times 10^{-4}} = \mathbf{12.2 \text{ bar}}$$

3. Thickness:

Consider FOS = 4 (high FOS is considered due to presence of human within the system)

We compared AISI 1014 Steel, Stainless Steel 304, and Aluminium 6000 series on various aspects like machinability, cost, durability, strength-to-weight ratio and found stainless steel to be the optimum material choice.

For Stainless Steel^[8], Yield Strength, $\sigma_{yt} = \mathbf{215 \text{ MPa}}$

$$\text{Maximum permissible stress, } \sigma_m = \frac{\sigma_{yt}}{FOS} = \frac{215}{4} = \mathbf{53.75 \text{ MPa}}$$

From manufacturer's catalogue^[7] we find thickness of actuator wall to be $\mathbf{2.75 \text{ mm}}$

$$\frac{D}{t} = \frac{32}{2.75} = 11.63 \leq 20$$

Thus **Thick Cylinder**^[9] theory is used.

Using **Clavarino's equation**^[9] since cylinder has closed ends and is made of ductile material,

$$t = \frac{D}{2} \left[\sqrt{\frac{\sigma_m + P(1-2\nu)}{\sigma_m - P(1+\nu)}} - 1 \right] = \frac{32}{2} \left[\sqrt{\frac{53.75 + 1.22(1-2 \times 0.3)}{53.75 - 1.22(1+0.3)}} - 1 \right] = \mathbf{0.3 \text{ mm}}$$

Thus required thickness of actuator wall is 0.3 mm which is less than 2.75 mm (actual thickness). Hence design is safe.

4. Hoop Stress^[10]:

$$\sigma_H = \frac{PD^2}{(D_o^2 - D^2)} \left[1 + \frac{(D_o/2)^2}{(D/2)^2} \right] = \frac{12.2 \times 10^5 \times 0.032^2}{(0.0375^2 - 0.032^2)} \left[1 + \frac{(0.0375/2)^2}{(0.032/2)^2} \right] = \mathbf{7.75 \text{ MPa}}$$

5. Longitudinal Stress^[10]:

$$\sigma_L = \frac{PD^2}{(D_o^2 - D^2)} = \frac{12.2 \times 10^5 \times 0.032^2}{(0.0375^2 - 0.032^2)} = \mathbf{3.268 \text{ MPa}}$$

6. Length of Piston Rod:

By Euler's Flexural Formula and considering $E = 200 \text{ GPa}$ for Stainless Steel,

$$F = \frac{(\pi^2)EI}{(L_e^2)}$$

$$I = \frac{\pi}{64} \times d^4 = \frac{\pi}{64} \times 0.012^4 = \mathbf{1.017 \times 10^{-9} \text{ m}^4}$$

$$L_e^2 = \frac{\pi^2 \times 200 \times 10^9 \times 1.017 \times 10^{-9}}{1962} = 1.022 \text{ m}$$

$$L_e = \mathbf{1.011 \text{ m}}$$

$$L = \frac{L_e}{0.5} = \mathbf{2.022 \text{ m}}$$

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Thus maximum permissible length $L = 2.022$ m, which is greater than the actuator length of 150 mm. Hence the design is safe.

X. FINITE ELEMENT ANALYSIS

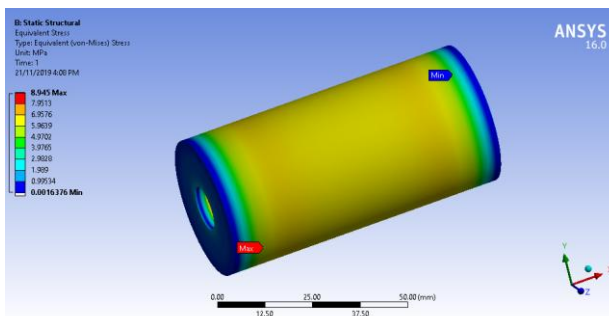


Fig. 3: Hoop Stress

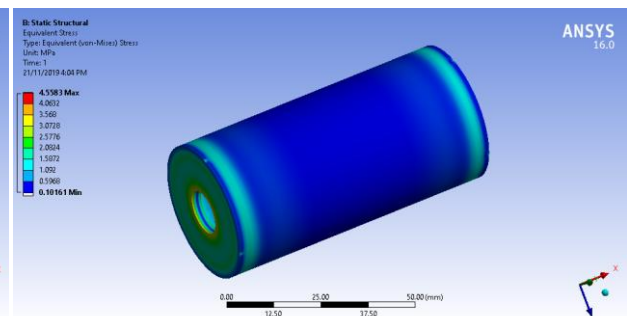


Fig. 4: Longitudinal Stress

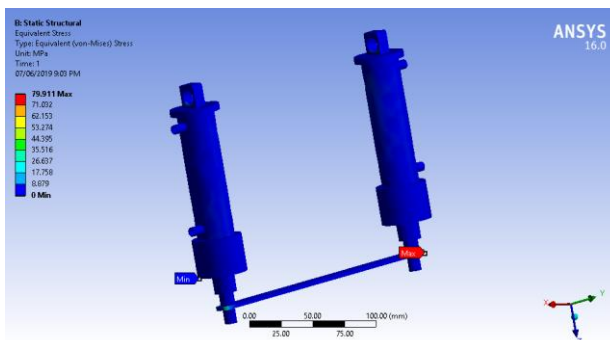


Fig. 5: Von Mises Stress

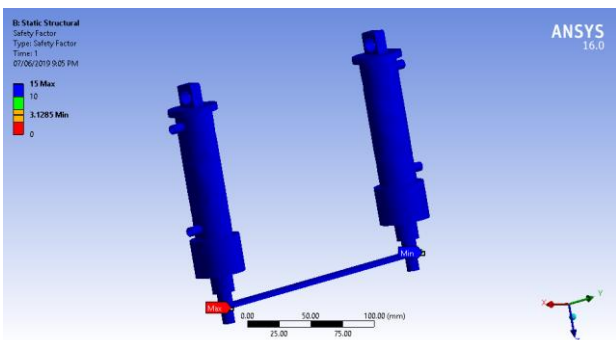


Fig. 6: Safety Factor

XI. PROPOSED DESIGN

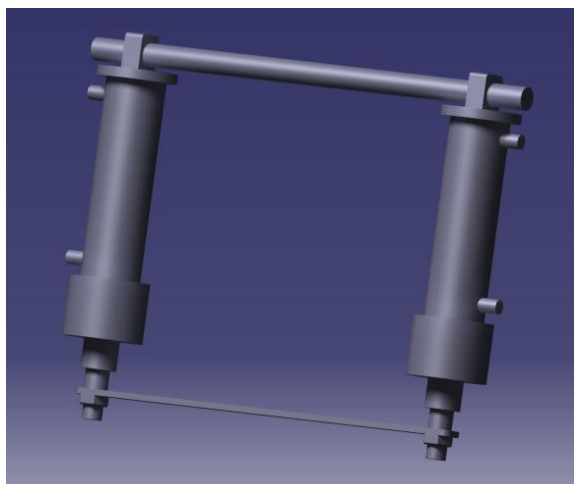


Fig. 7: CAD model of stand assembly

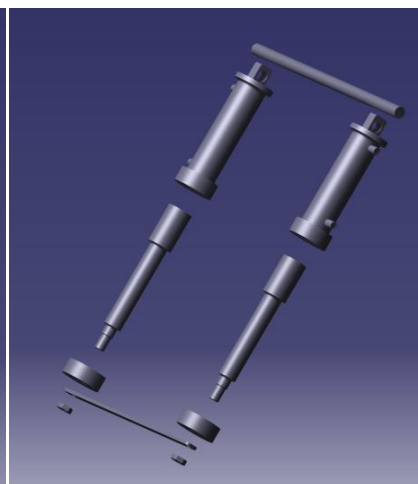


Fig. 8: Exploded View

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XII. SELECTION OF COMPONENTS

All the components were selected as per the system requirements.

1. Air Compressor:
https://www.amazon.in/Compressor-Heavy-Deluxe-Portable-Inflator/dp/B07YZN4V13/ref=asc_df_B07YZN4V13/?tag=googleshopdes-21&linkCode=df0&hvadid=396985905489&hvpos=1o5&hvnetw=g&hvrnd=1987752827591261882&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmid=&hvlocint=&hvlocphy=9040229&hvtargid=pla-83888527071&psc=1
2. Direction Control Valve:
<https://www.smcworld.com/products/en/directional/>
3. Flow Control Valve:
<https://www.smcworld.com/products/en/flowcontrol/>
4. Fittings and Tubing:
https://www.smcworld.com/products/en/fitting_tube/
5. Pneumatic Actuators:
https://www.smcworld.com/products/en/s.do?ca_id=458

XIII. CONCLUSION

Thus, we designed and fabricated a system which can automate the two wheeler centre stand and reduce human effort in its application.

REFERENCES

- [1] International Engineering Research Journal Page No 361-371 Design and Analysis of Standing Device for Two Wheeler Ankitkumar K. Shriwas¹, Vidyadhar C. Kale², K. V. Chandratre^{3,2,3} Department of Mechanical Engineering, Gokhale Education Society, R H Sapat COE Nashik, Savitribai Phule Pune University
- [2] International Journal of Innovations in Engineering and Science, Vol. 2, No.5, 2017 www.ijies.net 6 Design and Development of Automatic Centre Stand For Two Wheeler Ashish jyoti¹, Ajit Kumar², Nandlal Pandey³, Abhishek Mishra⁴, Pawan kr. Mahto⁵, Shailendra Kumar⁶, Amit Singh⁷, Piyush Ranjan⁸, Archiman Singh⁹, Asst.Prof.D.M.Hajare¹⁰ UG Students at Priyadarshini College of Engineering, Nagpur, Maharashtra, India D.M.Hajare: Asst.Professor, Dept. Of Mechanical Engineering, PCE, Nagpur, Maharashtra, India
- [3] https://m.timesofindia.com/auto/bikes/girls-driveindias_scooter%20boom/amp_articleshow/58426168.cms
- [4] <https://www.honda2wheelersindia.com/activa125-BS-VI/specifications>
- [5] <http://practical-engineering-topics.blogspot.com/2015/09/advantages-disadvantages-of-pneumatic.html>
- [6] <https://www.hydraulicspneumatics.com/other-technologies/book-2-chapter-22-synchronizing-cylinder-movement>
- [7] <https://www.smcworld.com/en-jp/>
- [8] <http://asm.matweb.com/search/SpecificMaterial.asp?bassnum=mq304a>
- [9] <https://www.uotechnology.edu.iq/dep-materials/lecture/fourthclass/Eng.Mat.Design03.pdf>
- [10] <http://www.mydatabook.org/solid-mechanics/stress-for-thick-walled-cylinders-and-spheres-using-lames-equations/>