

# DEVELOPMENT IN DESIGN AND FABRICATION OF HYDRAULIC WHEEL CHAIR

*Subtitle as needed (DEVELOPMENT IN DESIGN AND FABRICATION OF HYDRAULIC WHEEL CHAIR)*

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**Abstract :-** This article discusses the design of a cost-effective, feature-rich wheelchair for bedridden individuals in low-resource settings. It introduces a hydraulic system for adjustable height, enhancing ergonomics and safety. The wheelchair uses a hydraulic jack for lifting, mild steel for the frame, and foldable seating for portability. It is specifically designed to assist with washroom activities, offering stability and control in confined, slippery spaces. The goal is to provide a practical, affordable alternative to current high-cost wheelchairs.

**Index Terms—**Introduction, Problem Statement, Literature Review, Objective, Methodology, Acknowledgement, References.

## INTRODUCTION

For centuries, mobility has been key to human independence and quality of life, but for those with mobility impairments, traditional wheelchairs often fail to navigate diverse terrains and adjust seat heights. These limitations have driven innovations in assistive technologies. Hydraulic systems, which transmit power through controlled fluid movement, offer a promising solution, enhancing wheelchair functionality. A hydraulic wheelchair could provide features like height adjustment, greater stability on uneven paths, and easier navigation over steps. This article explores how hydraulic systems can improve wheelchairs, offering more precise control, increased load capacity, and adaptability for users. The goal is to create more versatile, user-centered mobility solutions that empower individuals and reduce reliance on others.

## PROBLEM STATEMENT

When mobility challenges for moving between chairs, beds, or toilets difficult or even impossible to move safely, this hydraulic wheelchair make patients and caregivers safer and more comfortable from one place to another. Moving patients is a common task for nursing staff and one of the most demanded responsibilities for the body. Auxiliary patient transportation equipment can protect caregivers from excessive force injury caused by improper or excessive weight lifting, and ensure patient safety during the transfer process.

## LITERATURE REVIE

The literature underscores a pressing need for an affordable, ergonomic, and adaptable wheelchair solution. A hydraulic-based design offers a promising approach to addressing the limitations of conventional wheelchairs, especially for bedridden users in resource-constrained environments. The integration of hydraulic lifting, durable materials, and foldable design features can significantly enhance usability, safety, and independence for users and reduce strain on caregivers. The evolution of wheelchair technology—from traditional models to smart and hydraulically enhanced systems—reflects the growing demand for safer, more adaptive, and user-centered mobility solutions. Future research and development should focus on merging advanced functionality with cost-effectiveness, especially for low-income settings. By integrating hydraulic adjustments, dual controls, smart features, and robust materials, next-generation wheelchairs can significantly improve independence, safety, and quality of life for individuals with mobility impairments

## OBJECTIVE

The objectives of this research are centered around developing an innovative, user-friendly, and affordable mobility solution for individuals with limited mobility, particularly bedridden patients. The first objective is to design a next-generation wheelchair that can be disassembled or split into modular parts, making it easier to transfer patients from beds and improving overall accessibility. Secondly, the project aims to ensure that the wheelchair is adjustable and safe to use, providing ergonomic support and stability to meet the needs of various users in both home and healthcare settings. Lastly, the research focuses on fabricating a practical and reliable wheelchair at an affordable cost, ensuring that the final product is accessible to users in low-resource environments without compromising functionality or safety.

**METHODOLOGY**

Development In Design



Material Selection



Fabrication Work



Assembling All Parts



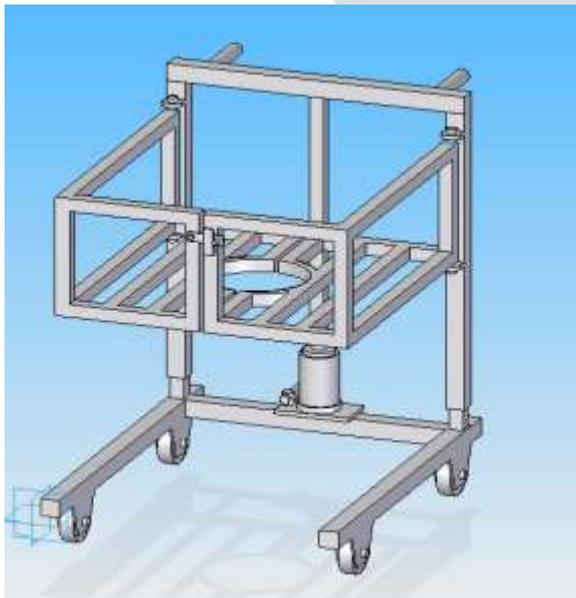
Prototype Testing Summary



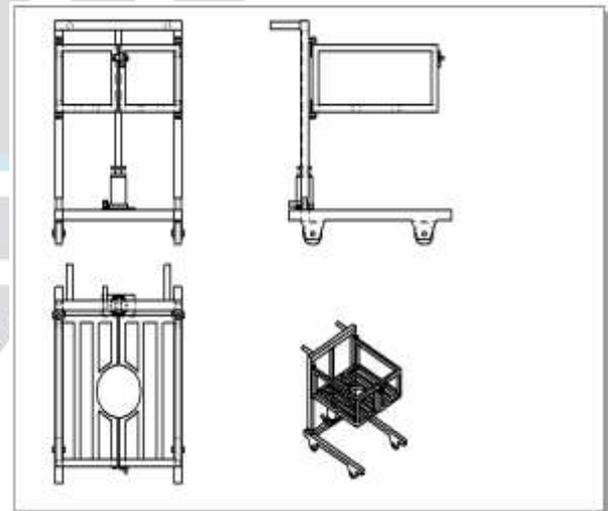
Final Evaluation

**DEVELOPMENT IN DESIGN**

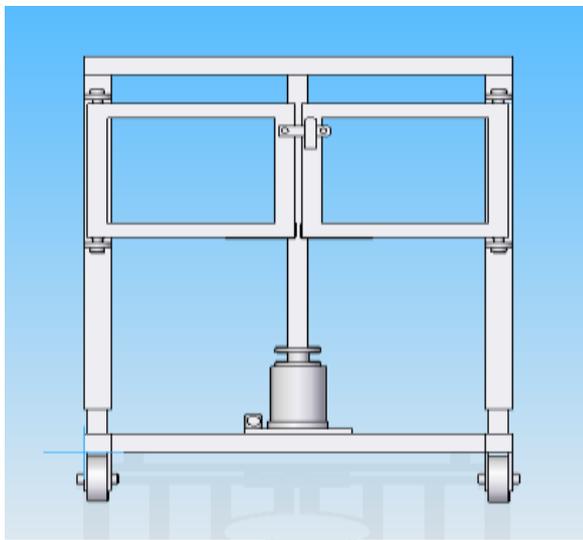
The design and development of the hydraulic wheelchair focused on enhancing user mobility, comfort, and independence. A key innovation is the integration of a hydraulic lift system that enables smooth and effortless seat height adjustment, allowing users to perform daily tasks more easily. The frame was constructed using lightweight yet strong materials such as aluminum alloy to ensure durability without compromising maneuverability. Core hydraulic components—including the pump, cylinder, reservoir, and control valves—were carefully selected to support adequate load capacity and ensure safe operation. The seating system was designed with ergonomics in mind, featuring cushioned support, adjustable armrests, footrests, and a tilting backrest for added posture control. Both manual and electric actuation options were considered to accommodate different user abilities. Prototype testing validated the system's strength, stability, and performance under various conditions. User feedback played a crucial role in refining the design to ensure real-world usability. The result is a practical, efficient, and user-friendly mobility solution.



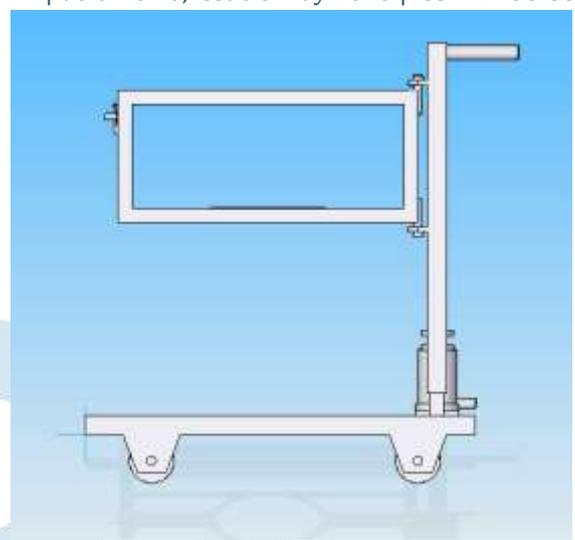
3D View



Drawing



Front View



Side View



Top View

## MATERIAL SELECTION

Material selection plays a vital role in ensuring the durability, functionality, and efficiency of a hydraulic wheelchair. Stainless steel was chosen for components requiring high strength and corrosion resistance, as it withstands extreme temperatures and heavy loads without deforming. Aluminum, known for its lightweight and corrosion-resistant properties, was selected to reduce the overall weight of the wheelchair while maintaining structural strength. Its natural oxide layer offers long-term protection, making it ideal for mobile applications. Mild steel, with its good weld ability, machinability, and low cost, was used in non-critical parts where strength is needed but corrosion resistance is less important. Each material was carefully evaluated based on mechanical performance, environmental exposure, and user safety. This strategic combination ensures optimal balance between strength, weight, and cost. Proper material selection also supports ease of manufacturing and maintenance. The final material choices enhance both the usability and lifespan of the wheelchair.

ASTM A36 is the most commonly used mild and hot-rolled steel. It has excellent welding properties and is suitable for grinding, punching, and tapping, drilling and machining processes. Yield strength of ASTM A36 is less than that of cold roll C1018, thus enabling ASTM A36 to bend more readily than C1018. Normally, larger diameters in ASTM A36 are not produced since C1018 hot roll rounds are used.

ASTM A36 is usually available in the following forms:

- Rectangle bar
- Square bar
- Circular rod
- Steel shapes such as channels, angles, H-beams and I-beams

## 1. ASTM A36 Steel



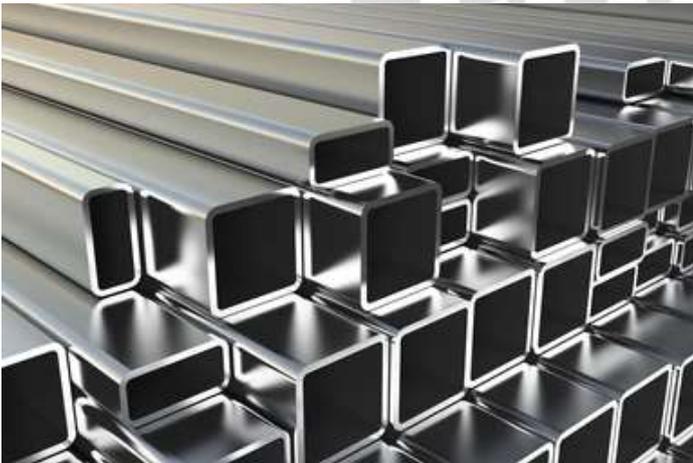
### Chemical Composition:

- Carbon (C): 0.26% max
- Manganese (Mn): 0.60–0.90%
- Phosphorus (P): 0.04% max
- Sulfur (S): 0.05% max
- Silicon (Si): 0.40% max
- Iron (Fe): Balance (approximately 98%)

### Mechanical Properties:

- Tensile Strength: 400–550 MPa
- Yield Strength: 250 MPa (min)
- Elongation: 20% min (in 200 mm)
- Hardness: 119–159 HB (Brinell Hardness)

## 2. Stainless Steel (Type 304)



### Chemical Composition:

- Iron (Fe): Balance (approximately 68–75%)
- Chromium (Cr): 18–20%
- Nickel (Ni): 8–10.5%
- Manganese (Mn): 2% max
- Silicon (Si): 1% max
- Carbon (C): 0.08% max
- Phosphorus (P): 0.045% max
- Sulfur (S): 0.03% max

**Mechanical Properties:**

- Tensile Strength: 520–720 MPa
- Yield Strength: 205 MPa (min)
- Elongation: 40% (min)
- Hardness: 170 HB (Brinell Hardness)

**FABRICATION WORK**

The wheelchair was designed using average Asian adult body dimensions as a reference to accommodate a wide range of physical deformities commonly found in individuals with disabilities. This approach also provides flexibility for future adjustments as users' physical conditions improve. The main frame and structural components will be fabricated from either steel or aluminum rods. These materials will be joined using Gas Metal Arc Welding (MIG) for general structural strength and Gas Tungsten Arc Welding (TIG) where more precision is needed. Smaller parts will be assembled using screws, bolts, and nuts to allow for easy maintenance and part replacement. The use of mechanical fasteners also adds modularity to the design. To improve grip and handling, rubber will be installed on the wheelchair's handles and caster wheels. This increases the frictional force against the floor surface, enhancing stability. The added grip is especially beneficial on slippery or smooth surfaces. Overall, the fabrication process prioritizes strength, adaptability, and user safety.

**Fabricated Model Front view****Fabricated Model Back View****Fabricated Model Top view****PROTOTYPE TESTING SUMMARY REPORT (TEMPLATE)**

**Project Title:** DEVELOPMENT IN DESIGN AND FABRICATION OF HYDRAULIC WHEEL CHAIR

**Test Date:** May 10, 2025

**Location:** Workshop Testing Area, [JSS SCIENCE AND TECHNOLOGY UNIVERSITY MYSORE]

**Test Conducted By:** Project Design & Fabrication Team

**1. Objective:**

To evaluate the first prototype of the height-adjustable wheelchair in terms of structural strength, mobility, comfort, and user safety.

## 2. Description of Prototype:

The prototype is built using aluminum & MS rods joined with MIG and TIG welding techniques. It features a height-adjustable seat using a hydraulic mechanism, with rubber-enhanced handles and caster wheels to increase friction and improve user control.

## 3. Test Methods:

Load testing with weights up to 120 kg

Mobility tests on tile, concrete, and mildly uneven surfaces

Safety tests on ramps with 15° incline

Feedback collected from 3 volunteer users with different physical conditions

## 4. Results & Observations:

**Structural:** No deformation or weakness observed under load

**Mobility:** Smooth movement on all surfaces; minor resistance on rough patches

**Comfort:** Seat height and tilt functions worked; users reported good support

**Safety:** Brakes held well on slopes; rubber grips improved traction on smooth floors

**User Feedback:** Positive overall; one user suggested padded armrests for added comfort

## 5. Issues Identified:

Slight instability when fully extended at maximum height

Screws on one caster wheel loosened after repeated testing

Hydraulic control needs smoother actuation

## 6. Recommendations:

Reinforce the frame at height-extension joints

Use locking washers or thread-locking compound on caster screws

Refine hydraulic control for more precise adjustment

## 7. Conclusion:

The prototype met most performance and safety expectations and is suitable for further refinement. With minor adjustments, it can be prepared for broader user trials or small-scale production.

## ACKNOWLEDGMENT

We sincerely thank the Vice Chancellor, Registrar, and Principal of JSS Science and Technology University, Mysuru, for giving us the opportunity to carry out this project. We are especially grateful to our guides, Dr. Savitha M and Dr. Yerriswamy W, Associate Professors in the Department of Industrial and Production Engineering, for their invaluable guidance and support throughout the project. We also extend our thanks to the faculty and staff of the department for their assistance. Lastly, we appreciate all those who directly or indirectly contributed to the successful completion of this major project.

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