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Fabrication Practice and Techniques for Go-Kart

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Abstract: ***This paper is focused on the fabrication of a high-performance go-kart using suitable material. The main objective is to construct a robust and lightweight chassis that can withstand the extreme hard conditions of racing while ensuring safety and performance. The fabrication process will involve cutting, welding, and assembling various components, including the frame, engine mounting, axles, and steering system. The project will explain the step-by-step fabrication techniques going to be used, including the selection of appropriate tools and equipment, as well as safety measures to be followed during the process. Special attention is given to precision in measurements and weld quality to ensure structural integrity with possible cost efficiency.***
Keywords: Fabrication, cutting, welding, steering, engine, chassis, robust, lightweight

I. INTRODUCTION

This paper concentrates on fabrication process involved in making of a Go Kart based on the rules and regulations in ISNEE Motorsport's (Indian Society of New Era Engineer) 12th GKDC rulebook 2024 (This rule book changes every year on considering the safety and innovative ideas). This paper will explain the fabrication techniques and appropriate fabrication process that are going to perform for fabrication of a Go Kart. The primary objective is to fabricate a strong and robust Go kart by applying our engineering skills. To achieve this goal, essential fabrication techniques, including cutting, welding, and assembly, while emphasizing safety and quality control are explored. Ultimately, this project not only enhances understanding of mechanical principles but also improved problem-solving skills create a functional and efficient go-kart.



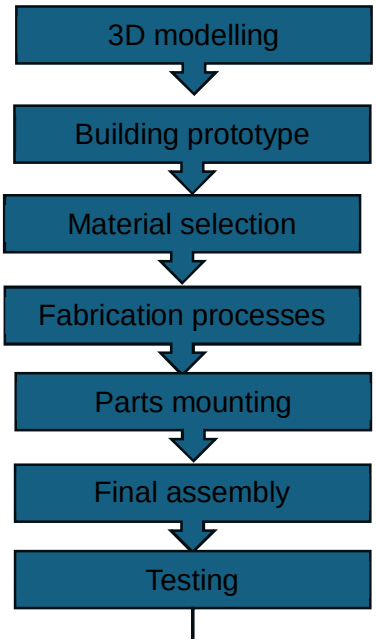
Go kart

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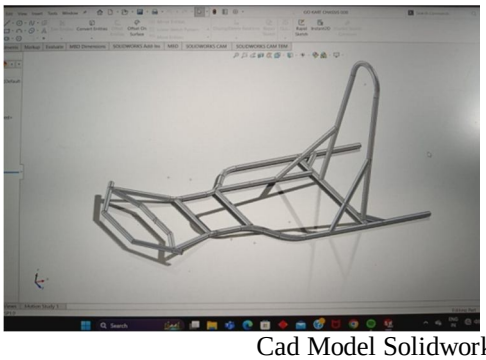
II. METHODOLOGY

The steps shown in following flow chart are adopted to develop the Go-kart.



III. CAD MODEL

Building a prototype according to CAD model before fabrication is important because it helps to test the design and functionality, saves money by identifying issues early, allows for material experimentation, provides user feedback, enables design refinement, and reduces risks of failure in the final product. Overall, it ensures a more effective and efficient final design.




Cad Model Solidwork- 2024 Plastic Prototype Model

IV. FABRICATION PRACTICES AND TECHNIQUES

The material selection is carried out to use proper material with required mechanical properties. It is discussed below. The various fabrication processes used are also discussed here.

A. Materials Selection

The material AISI-4130 is employed in the Frame (chassis) design due to its good strength, toughness, weldability & machinability. A good strength Material is vital during a roll cage because the roll cage has to absorb the maximum amount of energy as possible to stop the roll cage material from fracturing at the time of high impact. AISI- 4130 has been chosen for the Chassis because its structural properties provide a low weight to strength ratio. Material EN24 is used for shaft and cast iron is used wheel knuckle because it responds under specific stresses, which helps to determine its suitability for different applications.

Yield strength is the lowest stress that produces a permanent deformation in a material from the combine research and data we got form various research papers found that AISI 4130 is the material which fulfils every required conditions. Chassis components need

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to be welded, hence the weldability of the material should be good. Hence AISI 4130 is proper material for fabrication Go-kart chassis.

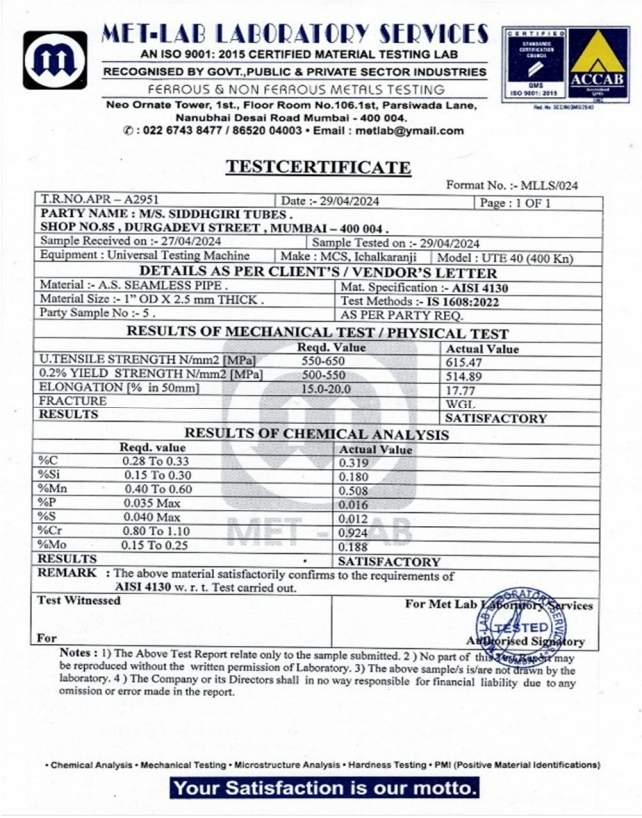
From the research, it is found that the circular tube is suitable and sustainable to fabricate the chassis. In a circular tube, it is found that the weight distribution on the hollow circular frame is equally distributed as compared to the square tubes. The chassis subjected to various kinds of forces during locomotion, it has to stay intact without yielding, and it should be stiff enough to absorb vibrations. The circular tubes are best suitable for handling the torsional (twisting) forces making them ideal for chassis that need to endure high stress. It has been found that circular tube frame is cost efficient. Also damages to the chassis can be easily rectified.

Table 1: Comparison of mechanical properties of different materials

Comparison Factor	AISI 4130	AISI 4140	Grey Cast Iron G1800	SAE 1018	ASMT A710
Density (X1000)	7.85 Kg/M^3	7.85 Kg/M^3	7.15 Kg/M^3	7.87 Kg/m^3	7.85 Kg/M^3
Tensile Strength (U)	670 MPa	655 MPa	440 MPa	440 MPa	585 MPa
Yield STRENGTH (Y)	460 MPa	415 MPa	400 MPa	370 MPa	515 MPa
Modulus Of Elasticity	190-210 GPa	190-210 GPa	95-110 GPa	205 GPa	205 GPa
Bulk Modulus	140 GPa	140 GPa	90 GPa	135 GPa	160 GPa
Shear Modulus	80 GPA	80 GPA	75 GPa	80 GPa	80 GPa
Poissons Ratio	0.27-0.30	0.27-0.30	0.26	0.29	0.29

Materials should be selected based on strength, weight, and cost. Common choices include AISI 4130, AISI 1080, and AISI 1020 steel for the frame due to its excellent mechanical properties and weld ability. All these materials were analysed for different parameters and finally Chromoly steel 4130 is selected for making the tubular chassis. Material testing report is given below.

Material testing report



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TESTCERTIFICATE

Format No. :- MLLS/024

T.R.NO.APR – A2951	Date :- 29/04/2024	Page : 1 OF 1
PARTY NAME : M/S. SIDDHGIRI TUBES .		
SHOP NO.85 , DURGADEVI STREET , MUMBAI – 400 004 .		
Sample Received on :- 27/04/2024	Sample Tested on :- 29/04/2024	
Equipment : Universal Testing Machine	Make : MCS, Ichalkaranji	Model : UTE 40 (400 Kn)

DETAILS AS PER CLIENT'S / VENDOR'S LETTER

Material :- A.S. SEAMLESS PIPE .	Mat. Specification :- **AISI 4130**
Material Size :- 1" OD X 2.5 mm THICK .	Test Methods :- **IS 1608:2022**
Party Sample No :- 5 .	AS PER PARTY REQ.

RESULTS OF MECHANICAL TEST / PHYSICAL TEST

	Reqd. Value	Actual Value
U.TENSILE STRENGTH N/mm2 [MPa]	550-650	615.47
0.2% YIELD STRENGTH N/mm2 [MPa]	500-550	514.89
ELONGATION [% in 50mm]	15.0-20.0	17.77
FRACTURE		WGL
RESULTS		**SATISFACTORY**

RESULTS OF CHEMICAL ANALYSIS

	Reqd. value	Actual Value
%C	0.28 To 0.33	0.319
%Si	0.15 To 0.30	0.180
%Mn	0.40 To 0.60	0.508
%P	0.035 Max	0.016
%S	0.040 Max	0.012
%Cr	0.80 To 1.10	0.924
%Mo	0.15 To 0.25	0.188
RESULTS		**SATISFACTORY**

REMARK : The above material satisfactorily confirms to the requirements of **AISI 4130** w. r. t. Test carried out.

Test Witnessed — **For Met Lab Laboratory Services**

For — Authorised Signatory

Notes : 1) The Above Test Report relate only to the sample submitted. 2) No part of this report may be reproduced without the written permission of Laboratory. 3) The above sample/s is/are not drawn by the laboratory. 4) The Company or its Directors shall in no way responsible for financial liability due to any omission or error made in the report.

• Chemical Analysis • Mechanical Testing • Microstructure Analysis • Hardness Testing • PMI (Positive Material Identifications)

Your Satisfaction is our motto.

B. Cutting

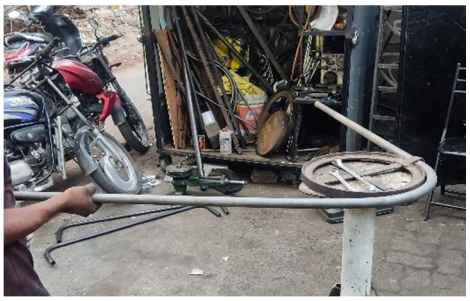
- Angel grinder is use as it is very affordable, since grinders and discs are inexpensive.
- Angle grinder provides quick, rough cuts or on-site modifications and it is fast for small cutting jobs.

C. Shaping/bending

- It is studied that bends distribute stress more evenly across the chassis, reducing the risk of failure
- Bends help to minimize these stress points, enhancing the overall fatigue life of the chassis.



Cutting



Bending

Various bending methods are available as rotary draw bending, compression bending, mandrel bending, roll bending and hot bending. Comparing these materials for precision, cost effectiveness and their applications, it is decided to use rotary draw for tube bending as it is highly precise for bends and is also economical.

D. Machining and Drilling

- Most machining process on axel hubs and brackets are done on the Lathe and Drill machine as it is available in our workshop to save labour costs.
- Machining process here involves Milling, turning, Grinding and Drilling etc.

E. Welding Process

Various welding processes as SMAW (Shielded Metal Arc- Welding), TIG (Tungsten inert gas Welding) and MIG (Metal inert gas Welding) are studied. On comparing it is found that MIG welding is best for very high strength welds and excellent finish with high precision work on thin metal tubes.

Comparison by considering parameters such as cost, strength, finishing, weldability & specifications is carried out. MIG welding is cost efficient and fulfils most of the major requirements. So MIG welding process is used to fabricate high strength, robust and light weight chassis for Go-kart.

Metal Inert Gas welding is a welding process in which an electric arc forms between a Consumable wire electrode and the work piece, which heats the work piece, causing them to melt and join.

F. Finishing Processes

- After inspecting, grinding on rough or sharp surface with grinder wheel for smooth finish is performed.
- Protective paint (primer) as coatings to prevent corrosion is applied.

G. Mounting and Final Assembly

- Assembly of the main chassis and all other parts are done, ensuring that all parts fit correctly. Fixtures are used wherever required for proper position.
- Other key components, such as the steering column, suspension, and engine mounts are integrated. It is needed to ensure that all systems are aligned and secure.
- Perform final inspections on the assembled go-kart, checking for alignment, structural integrity, and overall aesthetics.

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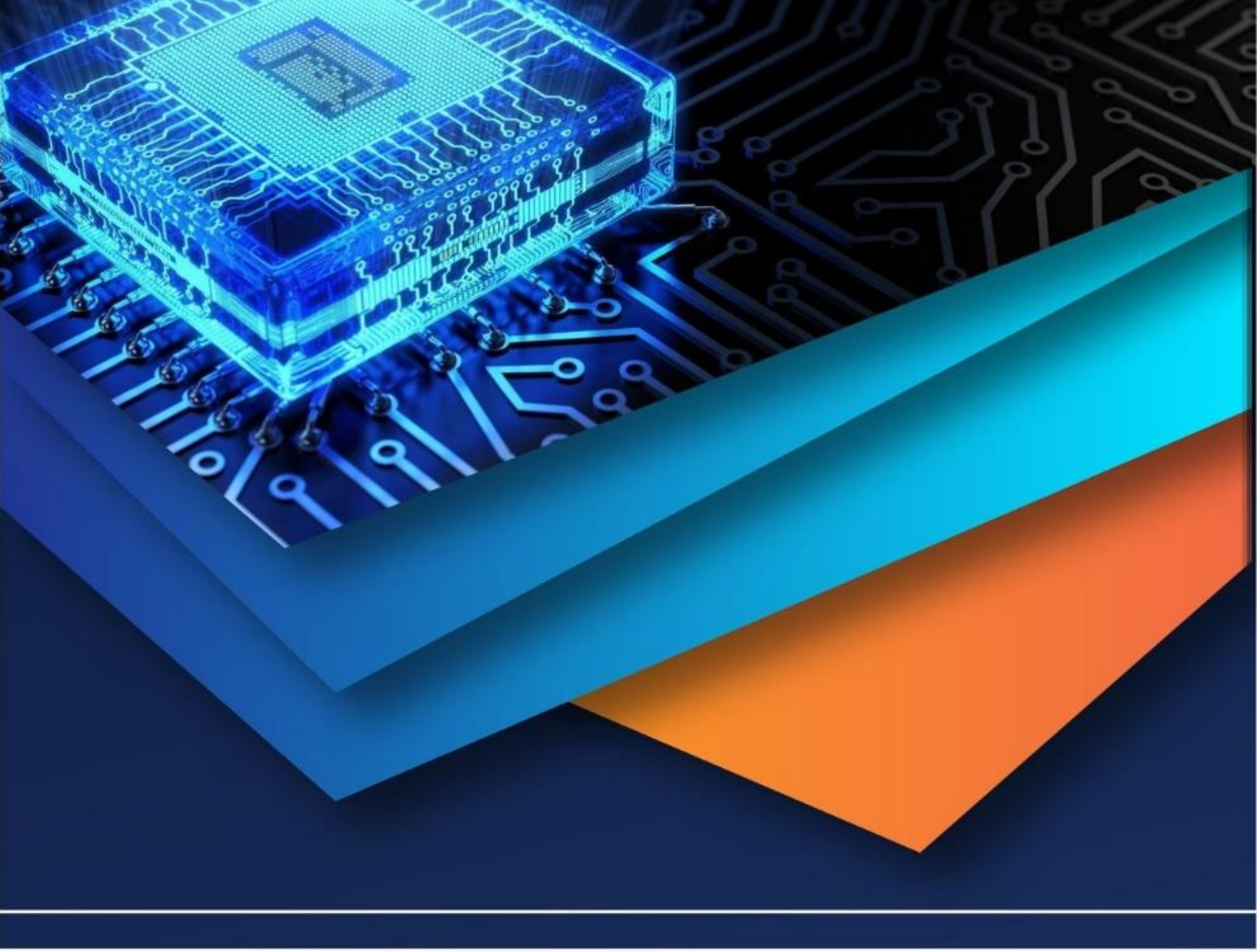
V. CONCLUSION

The fabrication of the go-kart project has successfully done with the application of engineering principles and hands-on skills. Through careful design, material selection, proper fabrication processes and assembly processes, functional and robust vehicle is developed that meets performance expectations and also satisfies the preferred rulebook.

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