

# **ANALISIS PENGARUH DIAMETER DAN KETEBALAN PIPA PADA STRUKTUR RANGKA *ROLLCAGE* MOBIL RALLY MENGGUNAKAN METODE ELEMEN HINGGA DAN DESIGN OF EXPERIMENT**

**Earlneo Joas Gerald Pasaribu**

## **ABSTRAK**

Rollcage merupakan komponen struktur keselamatan berupa rangka pipa baja yang berfungsi melindungi pengemudi dan co-driver mobil rally dari cedera fatal akibat kecelakaan seperti rollover atau benturan keras. Penelitian ini bertujuan untuk menganalisis pengaruh variasi diameter dan ketebalan pipa terhadap kekuatan struktur rollcage mobil rally menggunakan kombinasi metode Finite Element Method (FEM) dan Design of Experiment (DOE) dengan pendekatan Taguchi. Simulasi dilakukan menggunakan perangkat lunak ANSYS Workbench dengan material AISI 1080, dengan dua parameter yaitu diameter (45, 50, dan 55 mm) dan ketebalan pipa (2,5, 2,75, dan 3 mm), sehingga menghasilkan sembilan kombinasi desain. Parameter respons yang dianalisis meliputi Total Deformation dan Equivalent Von Mises Stress akibat pembebanan sebesar 9000 N pada bagian main hoop. Hasil simulasi desain awal (diameter 50 mm, ketebalan 2 mm) menunjukkan deformasi maksimum sebesar 1,1235 mm dan tegangan Von Mises maksimum sebesar 80,567 MPa, yang masih berada di bawah yield strength material sehingga desain dinyatakan aman. Hasil analisis Taguchi menunjukkan bahwa peningkatan diameter dan ketebalan pipa cenderung menurunkan nilai deformasi dan meningkatkan kekakuan struktur. Berdasarkan analisis gabungan Response Table dan Main Effect Plot terhadap kedua respons, kombinasi parameter optimum diperoleh pada diameter 50 mm dan ketebalan 3 mm, yang memberikan keseimbangan terbaik antara kekuatan dan kekakuan struktur terhadap pembebanan rollover.

**Kata kunci:** Rollcage, Finite Element Method, Design of Experiment, metode Taguchi, ANSYS

**ANALYSIS OF THE EFFECTS OF PIPE DIAMETER AND WALL THICKNESS  
ON THE ROLL CAGE STRUCTURE OF A RALLY CAR USING THE FINITE  
ELEMENT METHOD AND DESIGN OF EXPERIMENTS (DOE)**

**Earlneo Joas Gerald Pasaribu**

**ABSTRACT**

*A rollcage is a safety structure made of steel tubing designed to protect the driver and co-driver of a rally car from fatal injury during accidents such as rollovers or high-impact collisions. This study aims to analyze the effect of pipe diameter and thickness variations on the structural strength of a rally car rollcage using a combined Finite Element Method (FEM) and Design of Experiment (DOE) approach based on the Taguchi method. Simulations were performed in ANSYS Workbench using AISI 1080 material, with two parameters, diameter (45, 50, and 55 mm) and pipe thickness (2.5, 2.75, and 3 mm), resulting in nine design combinations. The response parameters analyzed were Total Deformation and Equivalent Von Mises Stress under a 9000 N load applied to the main hoop. The initial design simulation (50 mm diameter, 2 mm thickness) produced a maximum deformation of 1.1235 mm and a maximum Von Mises stress of 80.567 MPa, both below the material's yield strength, indicating the initial design meets the safety criteria. The Taguchi analysis showed that increasing pipe diameter and thickness tends to reduce deformation and improve structural stiffness. Based on the combined Response Table and Main Effect Plot analysis of both responses, the optimum parameter combination was found at a 50 mm diameter and 3 mm thickness, providing the best balance between structural strength and stiffness under rollover loading.*

**Keywords:** *Rollcage, Finite Element Method, Design of Experiment, Taguchi method, ANSYS*