Design and Structural Analysis of an Aerial Cable Transport Cabin

Kanishk Tiwari
School of Mechanical and Materials Engineering, Indian Institute of Technology Mandi, Himachal Pradesh, India

Rajeev Kumar
School of Mechanical and Materials Engineering, Indian Institute of Technology Mandi, Himachal Pradesh, India

M. Talha
School of Mechanical and Materials Engineering, Indian Institute of Technology Mandi, Himachal Pradesh, India

Abstract:

Urban ropeway transport systems require passenger cabins that are both lightweight and structurally dependable to ensure safe operation under various service conditions. Designing such cabins is challenging because they must withstand the combined effects of passenger loads, strong winds, hail impact and dynamic forces during station entry, while still maintaining sufficient strength, stiffness and overall safety within a compact structural layout. This paper presents a detailed structural design and assessment of the critical load-bearing components of a newly developed ten-passenger aerial ropeway cabin, carried out in line with international safety standards. All essential operational and environmental loads including the self-weight of the structure, non-structural components, passenger loading, wind action, hail impact and dynamic forces during station entry have been carefully evaluated and applied to the structural model. The cabin frame and the coupling element support are designed using Aluminum 6061-T6, while the H-bracket is fabricated from ASTM A572 Grade 50 steel. Finite element analysis is carried out to evaluate deformation, von Mises stress response and factors of safety of the critical structural components under the governing load combinations. The H-bracket is found to experience a maximum stress of 66.20 MPa with a safety factor of 5.21. All result values remain well within elastic limits, confirming compliance with international design standards and validating that the proposed critical component configuration is lightweight, structurally safe, and suitable for manufacturability, prototype development and integration into urban ropeway systems.

Keywords:

Aerial cable transport, finite element analysis, H-bracket, ropeway cabin, structural design, Dynamic Load Evaluation, Urban Ropeway Systems.