DEVELOPMENT, ANALYSIS AND MONITORING OF DISMOUNTABLE TENSEGRITY STRUCTURE

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CERTIFICATE

This is to certify that the thesis entitled, "**DEVELOPMENT, ANALYSIS AND MONITORING OF DISMOUNTABLE TENSEGRITY STRUCTURE**", submitted by **Mr. Ramakanta Panigrahi** to Indian Institute of Technology, Delhi, for the award of the degree of the **Doctor of philosophy** is a record of bonafide research work carried out by him. He worked under our supervision for the submission of this thesis, which to the best of our knowledge has reached the requisite standard.

The research reports and the results presented in this thesis have not been submitted in parts or in full to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Thousands of people are rendered homeless and displaced during natural calamities in different parts of the globe every now and then. A low-cost dismountable shelter can be a boon to the homeless during these situations. Tensegrity structures offer the most attractive solution for the purpose of temporary shelter due to their flexibility, lightweight, low cost, self-supporting configuration and reusability. The research on tensegrity structure has recently become an area of interest worldwide.

This thesis primarily focuses on the development, analysis and monitoring the behaviour of a new type of tensegrity based dismountable roof structure. First, a single module, measuring 1mx1m in size, is fabricated using half-cuboctahedron configuration. Instrumentation is carried out right at the fabrication stage. The structure is subjected to destructive load test during which continuous monitoring of the prestress levels, deflections and strains in the members is carried out. The monitored structure is also analyzed using finite element method (FEM) and the numerical results compared with the experimental observations. Further, the numerical model is updated for detailed parametric studies. The investigations are then extended to a tensegrity grid, 2mx2m in size, built by cohesive integration of four single tensegrity modules. In order to make sure that the structure is dismountable, an opening/closing mechanism is devised in one of the cables. The behaviour of the tensegrity structure under different loads (dead loads, live loads, lack of fit in cable, thermal loads and wind loads) and their combinations is studied in detail.

Apart from the fabrication and testing, a new methodology has been developed for design of tensegrity structures using artificial neural network (ANN) based on multilayered feed forward back propagation algorithm.

Further, feasibility of piezo-impedance transducers in identifying structural damage in a strut member based on electro mechanical impedance (EMI) technique is investigated. A new low cost version of EMI is successfully applied on tensegrity structures. Both strain gauges and piezo-transducers are found to complement each other by assisting in load history retrieval (LHR) and structural health monitoring (SHM) respectively. Piezo transducers is also used for global dynamic characterization of tensegrity structures and found suitable for obtaining information concerning the modes of vibration and damage identification of the structure.

Reasonable agreements are found between experimental and numerical studies. The research concludes with the findings obtained through experiments and numerical studies. It is hoped that this research will make significant contributions in the field of tensegrity structures.

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