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LIGHTWEIGHT STRUCTURES TECHNOLOGY FOR BRIDGES SMALL AND LARGE – SHORT HISTORY AND NEW DEVELOPMENTS

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SUMMARY

All sorts of bridges have been built by humans ever since they have decided to cross an obstacle on their way. Historically, various materials have been used as tension structural members carrying most, if not all, loads in all sorts of bridge-like structures for thousands of years, i.e. rope walkways in Chinese mountains. All sorts of hemp (and other natural fibers) ropes were utilized for smaller temporary structures, and in the sail ship industry, of course. Later, in mid centuries iron chains have been used to carry heavy loads of bridges and draw platforms.

In XIX century, one of the pioneers in light bridge structures was Eng. John Roebling, who introduced new materials and new technologies, which revolutionized the way bridges are constructed. Wire rope, cables and other high-tension structural members have evolved since those times, and new tensile materials have been invented to build bridges and other structures. Also, the advancement of engineering methods provides the scientific justification over the empirical believes for the advantage of tensile technology over traditional, gravity defying structural solutions. This paper will demonstrate new achievements in the development of tensile structural members and building methods.

Keywords: *Lightweight Structures, Cable Bridges, Fixed Length Cables, Fatigue Resistance, Tension Meter, Ultrasonic Load Measurement, Load Monitoring.*

1. INTRODUCTION

Roebling was not the first engineer to experiment with the tension structures for bridges and other structures. The first documented iron chain bridge was built in Bhutan in 1433. Bridges with wire rope hangers were built in England and France in early 1800 and steel rope bridge in America was built Roebling rival, Charles Ellet in 1842, and survived until 1875. Unfortunately, most of these early structures did not last for a long time, although there were some chain bridges in the UK, Spain and other countries, which remain in their function for a long time.

The innovation of Roebling's suspended structure design was principally based on the addition of relatively stiff deck structure. However, there were other components of the structural system, which made the suspension structure work, and these were: production of steel wire rope, an engineering method to build-up of the main suspension cable (parallel wires cable), connectors between main cable and hangers made of a stranded wire rope, and the concept of erection of bridge like structures. Many of his innovations held the US Patent, and some of them paved the way to the bridge engineering concept used until today. The results of these engineering innovations resulted in more efficient, more economical bridges, which can be built much faster and safer than the older technology bridges made with heavy materials like stone, concrete and steel trusses.

It is believed that Roebling and his family were the first to develop the process of fabrication steel wire rope remotely and delivering it to the construction site as a pre-fabricated product. Hence, he became the pioneer of the steel wire rope production and fabrication, as we know it today.

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