Biography

Suspension Bridge Master Li: Professor Guohao Li

"Prestress Technology" Editorial Office

Inspirations of youth, seeking only knowledge; Unconcerned by poverty, journeying afar in Germany; Fortunate to find excellent mentors, and encounter kindred spirits; Diligent in study, finding joy in forgetting worries; Amidst wars and chaos, what need for comfort; Unyielding in the face of great challenges, never giving up; Wandering back home, sighing over where my destiny lies.

—— Guohao Li

Figure 1 Guohao Li (1913 — 2005)

In 1936, while the construction of China's first modern bridge, the Qiantang River Bridge, was in full swing, a slender young man arrived at the construction site. As he gazed upon the magnificent Qiantang River Bridge, his excitement surged uncontrollably. Perhaps no one could have foreseen that at this moment, two of the most influential figures in modern Chinese bridge history would intersect. The former was the renowned bridge expert and designer of the Qiantang River Bridge, Mao Yisheng, while the latter was then an unknown student. Yes, he was Guohao Li.

Poor Childhood

Born in April 1913 to a farming family in Meixian, Guangdong, Guohao Li had a humble childhood. His father had been an apprentice in Thailand and later participated in the Xinhai Revolution before engaging in business endeavors in Indonesia. Meanwhile, young Guohao Li stayed behind with his mother. At a time when foreign

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invasions and warlord conflicts plagued the nation, life was difficult for the impoverished populace. Guohao Li, along with his mother, often engaged in farming and coal hauling to make ends meet.

Amidst these challenges, Guohao Li managed to enroll in Meixian No. 1 Middle School and attended the second year of junior high as a transfer student. In 1927, China was in turmoil, and young individuals with dreams participated in patriotic movements. Guohao Li, then in the third year of junior high, took part in a school speech competition with the theme of national development, ideals, and aspirations. He emerged as the winner and received a set of Dr. Sun Yat-sen's "The Strategy for Building a Nation," a book that sowed the seeds of patriotism in his heart.

By 1928, at the age of 15, Guohao Li had excelled and entered high school. However, his father's business in Southeast Asia was dwindling, and he urged Guohao Li to come abroad. Despite this, both Guohao Li and his mother were unwilling to give up on his education. After a brief dilemma, Guohao Li recalled his father's words about the potential profitability of becoming a doctor in Indonesia. He wrote to his father, proposing to study medicine first and then open a clinic in Southeast Asia. This time, his father agreed.

Study in Tongji

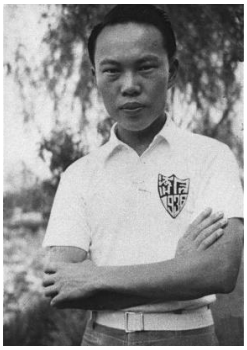

Figure 2 Guohao Li at the age of 16

In 1929, at the age of just 16 and without completing high school, Guohao Li arrived in Shanghai on his own and was admitted to the prestigious National Tongji University, known for its medical and engineering programs. This marked his first association with Tongji. After completing two years of preparatory German language studies, he not only became proficient in listening, speaking, reading, and writing in German but also self-studied to improve his skills in mathematics, physics, and English. This laid the foundation for his future studies, further education, and international academic exchanges.

Figure 3 Qiantang River Bridge groundbreaking ceremony

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Upon entering undergraduate studies, Guohao Li found himself uninterested in medicine and opted for engineering instead. Here, he embarked on the best years of his university life. In the spring of 1936, Guohao Li interned at the construction site of the Qiantang River Bridge in Hangzhou. It was during this time that he became deeply fascinated by bridges and was inspired by the patriotic sentiments of the bridge's designer, Mr. Yisheng Mao. This experience solidified Li's lifelong pursuit—bridge engineering—as he was about to graduate from his undergraduate studies.

In 1936, Guohao Li graduated with outstanding academic achievements and stayed at the university as a teaching assistant. In 1937, the Japanese invasion of China began with the Marco Polo Bridge Incident on July 7th. On August 13th of the same year, Japanese forces bombarded Shanghai, forcing the university to evacuate to safer areas. Due to the perceived risks, most of the German professors did not accompany the university during the evacuation, opting to stay in Shanghai or return to their home country.

During the university's evacuation, Guohao Li took over the steel structure and steel bridge courses in place of a German professor who had returned to Germany. This marked the beginning of his decades-long dedication to scientific research, teaching, and engineering practices in the field.

Study in Germany

In the autumn of 1938, Guohao Li received the Humboldt Scholarship to study abroad in Germany at the Technische Universität Darmstadt (Darmstadt University of Technology). Due to his outstanding performance, the university granted him permission to directly pursue a doctoral degree. He studied under Professor Klöppel. While Professor Klöppel welcomed Guohao Li's arrival, he was not entirely convinced of his academic abilities. As a test, he assigned Guohao Li the task of designing a three-span highway and railway dual-use suspension bridge (Hamburg Eibach River Bridge).

After more than two months, Guohao Li completed the design. Upon reviewing it, Professor Klöppel was very satisfied and agreed to let him proceed with his doctoral research. In the spring of 1939, Guohao Li officially began his doctoral research, which was centered around the theory of deflection of the Hamburg Eibach River dual-use suspension bridge. From the elastic bending differential equation of the deflection theory, he deduced that the force on the suspension bridge was equivalent to that of a beam under vertical loading and axial tension. This insight led him to develop a novel and practical calculation method for suspension bridges based on second-order theory. He validated his approach through model tests. Within less than a year, he completed his doctoral thesis and earned a Doctor of Engineering degree with exceptional honors.

Upon its publication in the "Steel Structures" journal, his thesis caused a significant impact in the field of bridge engineering, leading him to be known as "Hängebrücken (Suspension Bridge) Li." At that time, he was only 26 years old.

The outbreak of World War II prevented Guohao Li from returning to China. In early 1940, he took up research work in Professor Klöppel's laboratory and remained engaged in research until the end of the war. During this period, he was invited as the assistant to Prof. Klöppel in the compiling of German DIN 4114 Structural Stability Code. In 1943, his paper “Ample Criterion for Branch Point of Elastic Equilibrium” was published, in which he expounded the essential distinction between two types of stability from a theoretical height. In another paper, “New Calculation Method for Truss and Other Similar Structures”, he invented a new method to analyze truss structures, i.e., to systemize the discrete web member system into a continuous system and then acquire the solution by differential equation description. This practical method was close to the membrane theory of suspension bridges and was especially valuable in the 1940s before the invention of computers. This dissertation won him respects from many scholars.

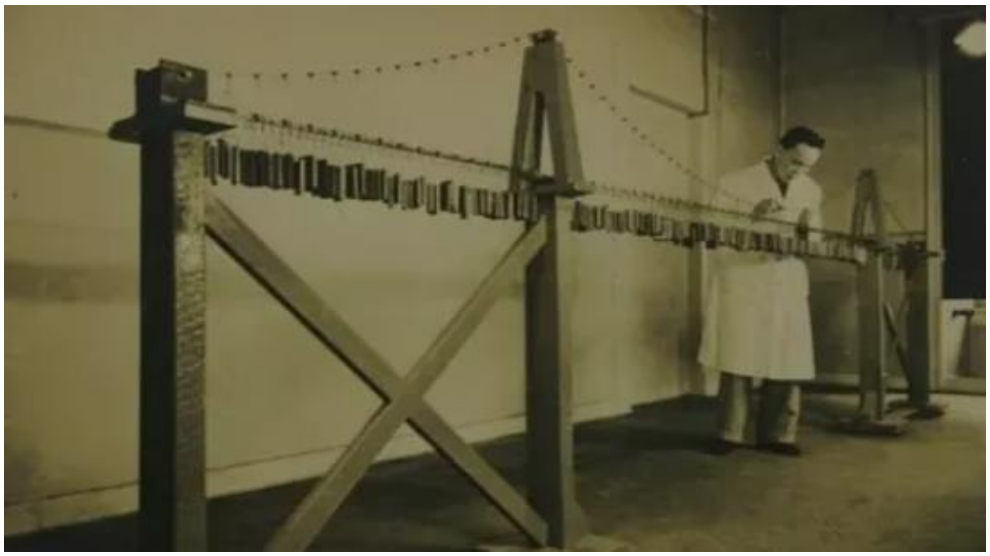

Figure 4 Guohao Li was experimenting

In 1942, Guohao Li conferred the degree of Dr. Ing. Habil. When he worked from 1942 to 1945 in Prof. Klöppel's Teaching and Research Group of Steel Structure, he led a vagabond life when Germany was bombed and plagued with starvation.

Return to Homeland and Decotion to China

After World War II ended, Guohao Li, having experienced great hardships, returned to China with his wife, Ms. Ye Jing'en. Their first child was born while waiting for the ship in Marseille, France and was named "Guihua", meaning "retuning to China", which expressed Li's desire to contribute to the rebuilding of postwar China. He returned to his alma mater Tongji University which had moved back from Sichuan to Shanghai. From then on he dedicated his life to the training of China's civil engineering talents.

In 1952, Guohao Li helped set up the major of Bridge Engineering and successively compiled and published two textbooks: Design of Steel Structures and Design of Steel Bridges. In 1955, he began to recruit graduate students of bridge engineering, and later, his first graduate textbook Stability and Vibration of Bridge Structures was published.

In 1955, Guohao Li became one of the first groups of academic divisions of the Chinese Academy of Sciences. He was the member and vice director of the Technological Consultant Committee for the construction of the Wuhan and Nanjing Bridges over the Yangtze River successively and played an important role in the construction of China's bridges over the Yangtze River.

In 1956, he was appointed vice president of Tongji University, in charge of research work. Soon, he initiated the Engineering Mechanics Department and taught the subjects "Structural Dynamics" and "Mechanics of Plates and Shells". In 1959, he initiated the Shanghai Mechanics Society and became chairman of the first executive council of the society. In the early 1960s, he established the Research Group of Structural Theory at Tongji University for research on anti-nuclear explosion engineering. By 1966, he had performed extensive research in the fields of bridge structures, engineering mechanics and explosion-resistant engineering and had trained a large number of talents in these fields, who became the core researchers in China and made great contributions to the motherland in her open-up endeavors in the 1980s.

A decade of Adversity

In 1966, the tumultuous period of the Cultural Revolution arrived. Guohao Li was unjustly accused and imprisoned in solitary confinement for two years. During this time, he learned about the opening of the Nanjing Yangtze River Bridge through

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a radio broadcast, which reminded him of the vibration phenomenon observed during the opening ceremony of the Wuhan Yangtze River Bridge. Despite having no resources armed with a solid theoretical foundation, acute creative thinking, and exceptional memory, he transformed the spatially discrete system of truss bridges into a continuous model. He established a system of differential equations to solve for elastic bending and torsion. With only the corners and crevices of newspapers, he conducted secret derivations and calculations with unwavering dedication. After nearly a year of relentless effort, he achieved preliminary success in theoretical analysis.

Following the end of the solitary confinement, during his period of supervised labor, he made a truss bridge model and conducted torsion experiments at home. He continued to refine his theoretical analysis and finally completed his painstakingly written monograph "Theory of Truss Torsion: Torsion, Stability, and Vibration of Truss Bridges" in 1973. This work not only explained the vibration issue of the Wuhan Yangtze River Bridge but also pioneered the analysis theory of truss bridge structures. In 1983, he was awarded the third prize of the National Natural Science Award.

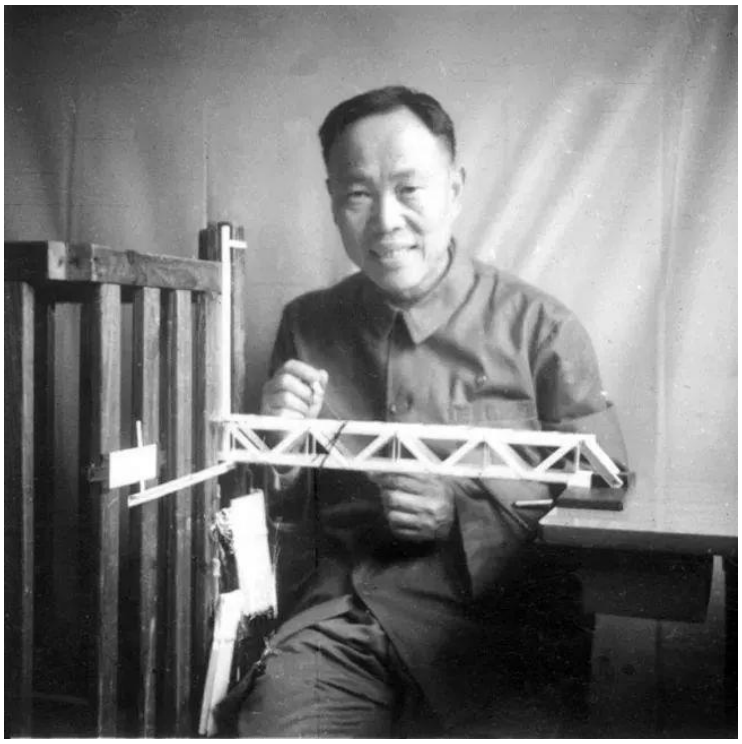

Figure 5 Guohao Li and his truss bridge model, 1971

While doing monitored and forced physical labor after the segregation, he made comprehensive research of the load transverse distribution on highway bridges, and after analysis of advantages and disadvantages of various solutions he put forward a new mechanics model which is based on very elemental principles but contains a variety of computation methods. He also drew practical diagrams and tables after tests of the new method's rationality and accuracy through model experiments. In 1977, he published the book The Computation of Load Transverse Distribution on Highway Bridges, which marked a conclusion of the 30-year traditional research and a great contribution to the spatial analysis in the bridge design field in China.

In the 1980s, Guohao Li published Aseismic Dynamics of Engineering Structures (1980) and Explosion-resistant Dynamics of Engineering Structures (1989). In 1987, he published his treatise Analyses of Box Girder and Truss Bridges abroad in English, which is a conclusion of his research in the field of bridge spatial analysis.

In 1997, Guohao Li actively encouraged the development of prestressed technology in China, inspiring schools and enterprises to explore the growth of the

prestressed industry and inscribed the title of "OVM Communication". He made important contributions to make China's prestressing technology among the forefront in the world.

Rejuvenation of Tongji

The nightmare of the “Cultural Revolution” ended in 1977. Guohao Li was rehabilitated and appointed president of Tongji University. He started his plan of rejuvenating Tongji University. Although he was at the age of retirement, he took painstaking efforts to restore the relationship between Tongji University and Germany and exerted himself to the utmost in Tongji’s transformation toward a comprehensive university.

In 1983, Guohao Li, at the age of 70, decided to retire and became honorary president of Tongji University. Then he was elected presidents of both the Shanghai Association for Science and Technology and Shanghai People’s Political Consultative Conference successively and started his busy social work. During the construction of Nanpu Bridge, Li appealed to Mr. Jiang Zemin, then Shanghai Mayor, for the self-design power of the construction and successfully won the support. Thus, the Chinese bridge construction circle enjoyed an opportunity for practice to make progress. The success of the construction of the Shanghai Nanpu Bridge inspired confidence in China’s bridge engineering field and finally formed a high tide of the self-design construction of bridges in China.

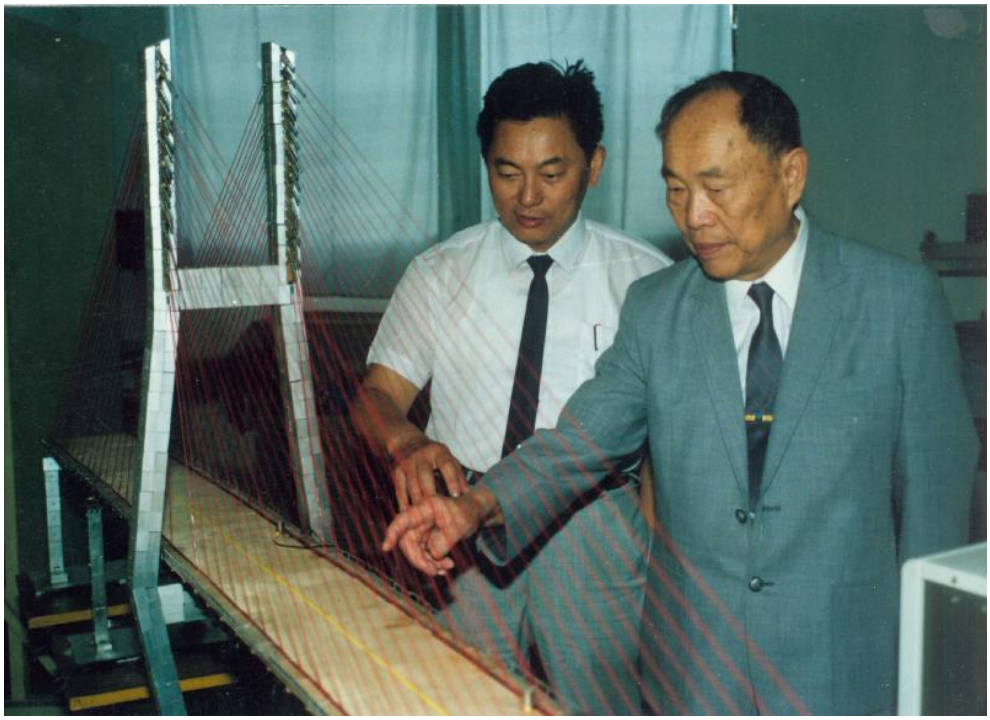

Figure 6 Nanpu Bridge in Shanghai. Aeroelastic model checking, 1989

In 1985, under the leadership of Guohao Li, Tongji University was authorized to construct the State Key Laboratory for Disaster Reduction in Civil Engineering and was supported with important facilities such as a large-scale shaking table and boundary layer wind tunnels. The laboratory has provided support for scientific research and experiments in China’s civil engineering construction. Consequently, Tongji’s state key discipline of bridge engineering is now in the lead in China and famous in the world.

Around the year 2000, together with other academicians, Guohao Li provided advice to national leaders regarding the construction of the Yangshan Port in Shanghai. He emphasized the importance of ports for the development of Shanghai, stating

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that "Shanghai has always thrived with its ports, and Yangshan Port is the lifeline of Shanghai's development." The Donghai Bridge served as a vital link between Shanghai and Yangshan Port. As China's first true cross-sea bridge, Guohao Li assumed the role of honorary consultant for the Donghai Bridge. This was the last bridge he was associated with in his 92-year-long life. He remained concerned about its progress until the very end. Unfortunately, he did not live to see the completion of the bridge and walk on it personally.

On February 23, 2005, Guohao Li passed away in Shanghai, marking a significant loss for the field of bridge engineering in China. Although President Li had passed away, his values of advocating for science, rigorous pursuit of truth, sincere dedication to the nation, and tireless dedication to education continue to endure, influencing generations of Tongji students.

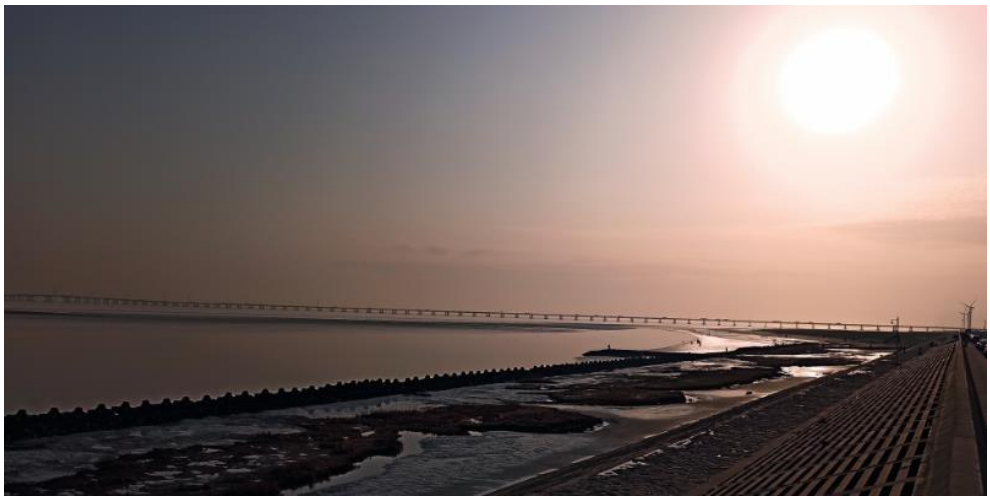

Figure 7 Donghai Bridge

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