

Timoshenko: Father of Engineering Mechanics

The legend of Timoshenko has few parallels in the annals of publishing technical books. For reading and understanding engineering mechanics the books of Timoshenko permeate a Shakespearean aura of authenticity and authority somewhat like Chandrasekhar's books on astrophysics. Timoshenko's books have been printed, sold, translated and reprinted in millions across the world ever since 1908 with the publication of his first book on strength of materials in Russian. His books have been translated into many major and minor languages including Arabic, Bengali, Fanti, French, Ga, Malay, Swahili, Urdu.... The list goes on and on as the Timoshenko legend grows bigger and bigger all the time....

The reputation of Timoshenko's books is built on the solid foundation of solving practical problems with artistic boldness and elegant mathematics. There is no place for hollow claims or mathematical sophistry in his books. He wielded such powerful influence on American engineering education and design practice that they call him "the Father of engineering mechanics". This is indeed a remarkable tribute considering that Timoshenko arrived in the US in 1922 at the age of 44! Timoshenko was indeed a giant of a teacher guiding 29 PhDs in the years 1927-37 at the University of Michigan and 9 more at Stanford during 1938-1947.

Before beginning his academic career in the US, Timoshenko was a technical consultant at the Westinghouse Corporation for five years. At Westinghouse, he organized the Applied Mechanics Division of the American Society of Mechanical Engineers (ASME). This has always been one of the largest and most active ASME sections, which publishes the famous *Journal of Applied Mechanics*. He also wrote two books: *Applied Elasticity and Vibration Problems in Engineering* while employed there.

Before emigrating to America, Timoshenko had already become an accomplished teacher and engineer in Russia and Europe. He had first-hand experience of life in Russia before and during the Communist Revolution. He studied in St. Petersburg during 1896-1901. During this period his fascination for bridges, harbours, cathedrals and ships spurred his summer trips to Western Europe twice, and, Germany, particularly, stimulated his mind greatly. Later, Timoshenko became an instructor at St. Petersburg Polytechnic Institute. While touring Europe many times Timoshenko was greatly inspired and influenced by Foppl and his student Prandtl in Germany.

In 1906 Timoshenko became the chair of Strength of Materials at the Polytechnic Institute in Kiev and rose fast to become the dean of Structural Engineering in 1909. Political conflict led to his dismissal from Kiev in 1911 and this perhaps drove him to leave Russia. Before he eventually reached America, Timoshenko worked in Yugoslavia founding the School of Engineering in Zagreb. Despite numerous torrid events and experiences that he endured during 1912-1922, Timoshenko contributed steadily to engineering mechanics. He also continued his habitual visits to Europe and interacted with Love, Southwell, Taylor, von Karman and others besides his German mentors: Foppl and Prandtl. It is indeed remarkable that although Prandtl, Taylor and von Karman began with solids and structures and switched over to fluid mechanics and aeronautics, Timoshenko never ventured outside his favourite field of structural mechanics.

His last book *As I Remember* written in 1963 when he was 85 is a moving account of his bitter-sweet Russian, European and American life. That his last book was first written in Russian underlines the deep feeling he had for Russia throughout his life. (This was later translated into English

in 1967). The legion of students and colleagues that Timoshenko advised and assisted includes names like Jacobsen, Soderberg, Hetenyi, Frocht, Goodier, Lee, Marin, Woinowosky-Kreiger, Nadai, Westergaard and many others. These people became the principal architects in building up the reputation of higher education in American universities in the latter half of the twentieth century.

This year marks the hundredth anniversary of Timoshenko joining the noble profession of teaching and also of his marriage in August 1902 to Alexandra. In his autobiography, Timoshenko remembers how his teachers helped him and how he managed with just a hundred roubles salary taking care of himself, his wife attending medical school, and his two brothers all under the same roof!

This year also marks the two hundredth anniversary of Young joining the Royal Institution as a professor and conducting the famous experiments to measure the Young's modulus of materials in 1802. Thomas Young initiated tension and tor-



sion tests on circular shafts, and raised a brilliant issue pertaining to the nonlinear dependence of the twisting moment on the angle of twist under end constraints. As it turned out some hundred years later, at the suggestion of Prandtl, Timoshenko took up the torsion problem for his dissertation. He formulated the torsion bending problem of non-circular beams with fixed ends with the help of a differential equation. This

equation adorns the postage stamp issued in Ukraine in 1998 to commemorate Timoshenko.

Timoshenko was a champion at bringing universities and industries together without ever compromising on the quality of education. This special blending of science and technology produced spectacular results at many American schools, but more conspicuously at Stanford and MIT where Timoshenko and his students were directly associated. Timoshenko's demise in 1972 signalled the end of a romantic era of teaching and writing books to promote engineering science education. The new era of computer simulation based education dominating modern universities has removed the need for qualified teachers and well equipped laboratories. Internet education has further reduced the investment on facilities while expanding the marketplace internationally. This new form of marketing education globally has brought in more administrators and advertising agents in the place of teachers. While it is true that the marketplace decides the short term outcome of a specific education, market demands are highly unpredictable. Only those who possess genuine education can hope to turn market fluctuations to their advantage. Recently, Nobel laureate Stiglitz debated such issues in his book *Globalization and its Discontents* (W Norton 2002). State universities and government schools appear to be the only hope for teaching and learning the fundamentals of engineering science through the reading of great books like those authored by Timoshenko.

For eons to come, the monuments erected by Timoshenko in the form of his books will continue providing great inspiration and confidence to students, teachers, scientists and designers pursuing structural engineering design and analysis.

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