Biography of Shen Shenfu



Crossing the Sound Barrier and the Century

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Chapter 1
A Young Man from Shanghai Amid the Flames of War in Chongqing (1921–1941)

Shen Shenfu was born in Shanghai on 31 August 1921. His ancestral home was Wuxing, Zhejiang Province. His father, Shen Zuwei, was an engineer, while his younger brother, Shen Zongying, later became a pharmaceutical scientist. Growing up in an intellectual family, Shen was immersed in an atmosphere of science and engineering from an early age.

In 1937, sixteen-year-old Shen entered the Department of Aeronautical Engineering at National Central University. That same year, the full-scale War of Resistance Against Japan broke out. The university was forced to relocate westward to Chongqing, and Shen spent his university years amid the turmoil of war. His fellow students included Feng Yuanchen, who later became a distinguished mechanician, and aeronautical engineering specialists Lu Xiaopeng and Lu Yuanjiu. He studied under professors including Luo Rongan, Huang Yushan and Xie Anhu.

Conditions at National Central University during its years in Chongqing were extremely difficult, yet the academic atmosphere remained remarkably vibrant. Japanese air raids frequently interrupted lectures, forcing professors and students to continue their discussions of aerodynamic equations inside

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air-raid shelters. In 1941, Shen graduated from the Department of Aeronautical Engineering with a bachelor's degree and subsequently joined the design division of the Aeronautical Research Institute in Chengdu.

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Chapter 2
MIT: A Student of Both Qian Xuesen and Chia-Chiao Lin (1943–1949)

In 1943, Shen Shenfu reached a decisive turning point in his life. He ranked first nationwide in the competitive examination for overseas study in aeronautical engineering and received a Tsinghua Boxer Indemnity Scholarship. He chose the Massachusetts Institute of Technology (MIT), where he studied under Qian Xuesen and Chia-Chiao Lin, two internationally renowned authorities in theoretical and engineering fluid mechanics.

Shen was one of five Chinese doctoral students trained by Qian Xuesen at MIT. Unlike Zheng Zhemin, Luo Shijun and several others, his doctoral dissertation was jointly supervised by Qian and Lin, allowing him to benefit from the intellectual guidance of both distinguished scholars. In 1949, he received a Doctor of Science (Sc.D.) degree in Aeronautical Engineering from MIT.

Regarding Shen's decision to remain in the United States, one interpretation suggests that his previous work within the Nationalist-controlled aviation establishment may have exposed him to institutional difficulties, influencing his eventual decision to continue an academic career in America. Whatever his reasons, that decision shaped the course of the remaining

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six decades of his life, establishing his professional home across the Pacific.

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Chapter 3
Maryland and Cornell: From Assistant Professor to Endowed Professor (1949–1991)

After completing his doctorate, Shen Shenfu spent two years as a research associate in the Department of Mathematics at MIT. In 1951, he joined the Department of Aeronautical Engineering at the University of Maryland as an Assistant Professor, advancing to the rank of full professor in 1957. During his eleven years in Maryland, he developed an independent research programme and established his reputation in aerodynamics and fluid mechanics.

In 1961, Shen made one of the most significant decisions of his professional career. At the strong invitation of the distinguished aeronautical engineer W. R. Sears, he joined Cornell University as Professor of Aeronautical and Space Engineering. Cornell became his academic home for the next thirty years. In 1978, he became an endowed professor of Mechanical and Aerospace Engineering, receiving the distinguished title of John Edson Sweet Professor.

In 1991, Shen retired from Cornell University and was granted the title of Professor Emeritus. Over his thirty years at Cornell, he educated and mentored successive generations of aerospace engineers.

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Chapter 4
Crossing Every Sound Barrier: Contributions Across the Full Spectrum of Aerodynamics

In its memorial tribute to Shen Shenfu, Cornell University offered a particularly apt description: “Professor Shen's work was remarkable for its diversity.” He “never stayed with any particular subject for very long.”

This diversity did not reflect superficial engagement. Rather, Shen made significant contributions to virtually every field he explored. His research encompassed transonic and hypersonic aerodynamics, aeroelasticity, finite element methods in aerodynamics, hydrodynamic stability, kinetic theory of gases, non-Newtonian fluid mechanics, rarefied gas dynamics, and the theoretical and computational analysis of boundary-layer separation, particularly unsteady flows around manoeuvring bodies.

His review of hydrodynamic stability was included in the classic High Speed Aerodynamics and Jet Propulsion series published by Princeton University Press, becoming a standard reference in the field. His work in non-Newtonian fluid mechanics also provided important theoretical foundations for polymer processing and plastic injection moulding.

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Chapter 5
The Cornell Injection Molding Program: From Laboratory Research to Industrial Applications (1974–1988)

Shen Shenfu's most unconventional engineering contribution emerged during the latter half of his professional career.

From 1974 to 1988, he served alongside Professor Wang Guojun as Co-Director of the Cornell Injection Molding Program (CIMP). Supported by the United States National Science Foundation, this high-risk, high-reward research programme aimed to solve practical engineering problems associated with the manufacture of plastic components.

Shen was responsible for the theoretical aspects of fluid mechanics and heat transfer within the programme. Working with C. A. Hieber, he published a paper in 1980 demonstrating that their predictions of melt-flow front positions and cavity pressure distributions closely matched experimental results. The efficient numerical methods they developed paved the way for subsequent analyses of polymer melt flow and solidification.

In 1979, the programme established an industrial consortium that eventually attracted more than fifty major corporations worldwide as members and beneficiaries. Shen's research into non-Newtonian flow and the properties of polymer melts became widely recognised for enabling the design and

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manufacture of countless plastic components used in modern electronics and consumer products. That an aerodynamicist ultimately made foundational contributions to the modernisation of the plastics industry was perhaps the clearest demonstration of the extraordinary diversity of his scientific interests.

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Chapter 6
Adviser to the United States Navy: From Ship Seakeeping to Aircraft Carrier Landings

Shen Shenfu's engineering expertise served not only academia and industry but also the defence sector of the United States.

He served as a consultant to the United States Navy's David Taylor Naval Ship Research and Development Center, providing expertise on ship seakeeping in severe sea conditions, the dynamics of large helicopters equipped with circulation-control rotors, and design modifications associated with aircraft carrier landings. For a researcher specialising in transonic aerodynamics to offer solutions to problems involving ships and helicopters reflected an exceptional capacity for interdisciplinary engineering practice.

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Chapter 7
An International Academic Career: From Zurich to Tokyo

Shen Shenfu's academic influence extended around the world. His professional record included an impressive series of visiting professorships and international research appointments.

In 1957, he received a Guggenheim Fellowship and conducted research at the Swiss Federal Institute of Technology in Zurich. In 1964 and 1969, he served twice as a Visiting Professor at the University of Paris. In 1977, he held a visiting professorship at the Vienna University of Technology. From 1984 to 1985, he served as a Visiting Professor at the Institute of Space and Astronautical Science at the University of Tokyo. In 1991, he was a Visiting Professor at the University of Rome.

In Taiwan, he served as a Distinguished Visiting Professor at National Taiwan University in 1991 and 1993, and at National Central University in 1995. In mainland China, he held honorary professorships at Southeast University, formerly National Central University, and Nanjing University of Aeronautics and Astronautics.

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Chapter 8
Academic Honours: Recognition from Three Distinguished Academies

Shen Shenfu's academic achievements received recognition from several of the world's most respected scientific and engineering institutions.

In 1958, he was elected to the Washington Academy of Sciences in the United States. In 1966, or according to some sources 1969, he became a Corresponding Member of the International Academy of Astronautics. In 1972, he was elected an Academician of Academia Sinica in Taiwan, as a member of its ninth class in the Division of Mathematics and Physical Sciences. In 1985, he was elected to the United States National Academy of Engineering in recognition of his “fundamental contributions to aerodynamics and non-Newtonian fluid mechanics.”

Election to the United States National Academy of Engineering is among the highest distinctions in the American engineering profession. Shen's election signified the exceptional recognition accorded to his contributions to fluid mechanics and aerodynamics by the international engineering science community.

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Chapter 9
Concluding Reflections: An Explorer Who Never Stopped

On 22 December 2006, Shen Shenfu passed away in Ithaca, New York, at the age of eighty-five. Cornell University's memorial tribute observed: “His legendary rigour, integrity and great imagination provided a shining example that would be difficult to follow.”

One defining characteristic ran throughout Shen Shenfu's life: an unceasing desire to explore. From transonic to hypersonic aerodynamics, from aeroelasticity to finite element methods, from fluid stability to rarefied gas dynamics, and from non-Newtonian flow to injection moulding, he made substantial contributions in each field before turning towards another subject that would challenge him. This intellectual restlessness did not arise from impatience or a lack of focus, but from a sustained curiosity about the boundaries of scientific knowledge.

From Shanghai to Chongqing, from MIT to Maryland, and from Cornell to Zurich, Paris, Vienna and Tokyo, Shen Shenfu devoted eighty-five years to a remarkable journey across the sound barrier and the century. His life's trajectory, much like the complex fluid flows he studied in aerodynamics, was diverse, profound and always moving forward.

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