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Overview of Professor Hayashi's contributions to composites R&D in Japan

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1. INTRODUCTION

Dr. Tsuyoshi Hayashi, Professor Emeritus at the University of Tokyo, Founder and Honorary Member of the Japan Society for Composite Materials, passed away suddenly at his home as a result of acute heart failure at the age of 86 on February 2nd, 1998. Everyone who knew him was shocked to hear the news of his sudden and unexpected passing, as he had been in good health and still active until quite recently. Dr. Hayashi made numerous significant contributions to the field of composite materials including his famous pioneering work on orthotropic bodies and structures. His enthusiasm towards the establishment of unified 'Composite Materials Engineering' had not diminished since he founded the Japan Reinforced Plastics Society (JRPS) in 1955 and the Japan Society for Composite Materials (JSCM) in 1975. Dr. Hayashi attended many overseas conferences on composite materials until quite recently and enjoyed a close intimacy with many distinguished overseas scholars and researchers. Dr. Hayashi was often known in overseas countries as the 'Godfather of Composites' in Japan. The Japan composite community has lost its great leader, and his constant inspiration, both personally and academically, will be solely missed. This article gives an outline of Dr. Hayashi's career and his contributions to composites R&D in Japan.

2. CAREER AND CONTRIBUTIONS

After graduating from the Department of Aeronautics, Faculty of Engineering, at the Imperial University of Tokyo in 1935, Dr. Hayashi stayed in the position,

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first of lecturer, and then associate professor from 1936. After the Second World War, Dr. Hayashi moved to the Department of Applied Mathematics, Faculty of Engineering, at the University of Tokyo in 1945 and was promoted to the position of professor in 1948. This was followed by moves to the Department of Applied Physics in 1951 and the Department of Aeronautics on its reopening in 1954. Dr. Hayashi retired from the University of Tokyo in 1972 and the title of Professor Emeritus was conferred on him. He became a professor in the Department of Mathematics, Faculty of Science and Engineering, Chuo University between 1972 and 1982.

Dr. Hayashi's research fields may be classified as structural mechanics, composite materials, biomechanics, and others. As far as composite materials are concerned, his work may be retraced to his pioneering basic studies on the theory of elasticity of orthotropic materials and structures during the Second World War when more emphasis was laid on wooden aircraft structures. He submitted his doctoral thesis entitled 'Theory of Elasticity of Orthotropic Structures' in 1946 and was granted the degree of Doctor of Engineering from the University of Tokyo in 1947. Dr. Hayashi was invited as a visiting professor at the Department of Aeronautics and Astronautics, Stanford University and gave his lectures on orthotropic bodies and structure from December 1961 to April 1962.

Dr. Hayashi noticed a new material created in the US in 1943, namely Fiber (Glass) Reinforced Plastics (FRP or GRP) as early as in 1952 and designed a glider with GRP for the Aero Club of the University of Tokyo. Thus the world's first GRP glider, 'LBS-II' (Light Blue Soarer II) and 'LBS-III' were fabricated with financial support of a glass fiber maker in 1954 and 1955. Since 1952, Dr. Hayashi had been continuing his study for establishing Composites Mechanics as a discipline, including many pioneering works such as compressive strength of unidirectional composites, stress distributions around a short fiber embedded in matrix, interlaminar stresses in composite laminates, hybrid composites, and so on.

Dr. Hayashi's enthusiasm attracted many colleagues around him to form and establish various societies in Japan. Dr. Hayashi founded the Japan Reinforced Plastics Society (JRPS) in 1955 and he was the first and the third President. He rendered remarkable services to lay the foundation of FRP industries in Japan. Dr. Hayashi organized the Composite Materials Research Committee as the Chairman in the Japanese Union of Scientists and Engineers in 1969 and led extensive research activity to cover all kinds of composites, MMC, CMC, as well as PMC. Dr. Hayashi founded the Japan Society for Composite Materials (JSCM), the world's first society for composites, as the first President in 1975. The previous activity was succeeded and enlarged to the new society. Dr. Hayashi has led and advised many projects in composites R&D in Japan as a man of influence. He was the Chairman of the Evaluation Committee in the first period of the National R&D Project on advanced composites in 1981 – 1988.

Dr. Hayashi received numerous national and international awards and decorations, including the first Medal of Excellence in Composite Materials from the University

of Delaware, Center for Composite Materials, in 1984, the Second-Order of the Sacred Treasure from the Japanese Government in 1984, and he was elected as a Foreign Associate of the US Academy of Engineering in 1986.

3. INTERNATIONAL ACTIVITIES

Dr. Hayashi was very enthusiastic about the international exchange of knowledge and information in the field of composite materials. He attended and organized many international conferences on composite materials. He was the general chairman of the *4th International Conference on Composite Materials* (*ICCM-4*) held in Tokyo in 1981. The Japan Society for Composite Materials has been very active in various levels of international companionship under his leadership such as joint conferences and workshops between Japan–USSR, Japan–US, Japan–China, Japan–Europe and so on, some of which still continues. The most representative

Figure 1. Japanese badminton of 'Compo-feather' between Japan and US (drawn by Dr. Hayashi).

example is the very successful series of Japan–US Conferences on Composite Materials which was led by his basic concepts and efforts. The 1st Conference was held in Tokyo in 1981, followed by the 2nd in Hampton in 1983, the 3rd in Tokyo in 1986, the 4th in Washington, DC in 1988, the 5th in Tama in 1990, the 6th in Orlando in 1992, the 7th in Kyoto in 1995 and the 8th in Baltimore in 1998.

The attached illustration was drawn by Dr. Hayashi at the Joint Meeting of Japan–US Organizing Committee Members in Tama in 1990. It shows the traditional Japanese badminton 'Hanetsuki'. The 'Compo-feather' is a symbol of the lightest-weight composite structure and his dream was that the exchange of knowledge and information on composites will continue forever between Japan and US.

Acknowledgements

On behalf of the Japan Society for Composite Materials, I would like to express my sincere thanks to the American Society for Composites for their friendship and consideration that the Plenary Session was dedicated to the memory of the late Dr. Hayashi at the 8th Japan–US Conference on Composite Materials, September 24–25, 1998, Baltimore, Maryland, USA.